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THE SEASONAL DISTRIBUTION AND ABUNDANCE OF MARINE BIRD POPULATIONS IN THE STRAIT OF JUAN DE FUCA AND NORTHERN PUGET SOUND IN 1978

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Marine Ecosystems Analysis Program
Boulder, Colorado
September 1979

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THE SEASONAL DISTRIBUTION AND ABUNDANCE OF MARINE BIRD POPULATIONS IN THE STRAIT OF JUAN DE FUCA AND NORTHERN PUGET SOUND IN 1978

David A. Manuwal, Terence R. Wahl, and Steven M. Speich

ABSTRACT

Marine bird populations were studied from 1 January, 1978, to 31 December, 1978, the first of two years, in the Strait of Juan de Fuca north to the San Juan Islands and Point Roberts and west to Sidney, British Columbia, to determine their time of occurrence, distribution, abundance, and locations of important concentrations. Bird census methods included: (1) point census, (2) sea watch, (3) beach census, (4) dead bird census, (5) small boat census, (6) ferry census, and (7) aircraft census. A total of 3,667 census sites and segments were sampled during 1978. Data were obtained on breeding marine birds on 138 islands in the study area.

All field data were coded according to NOAA/NODC-approved codes and formats. Key-punched data were read onto a disk file and later transferred to a storage tape. After errors were corrected, two cross-reference programs were run to arrange data into appropriate order for later analysis. During the 1978 survey period, 43,353 records were generated on five record types. Computer output included total birds observed, standard deviation, number of censuses, weighted density, projected total numbers, percent of projected total numbers (for each species), biomass, percent of projected total biomass, and bird oil index.

The study area was divided into 13 regions and 64 subregions. Where appropriate, open water and shoreline habitats were treated separately since they differ biologically.

Approximately 94% of a total of 29,600 pairs of 12 bird species nest on 35 islands in the San Juan Islands, Smith and Minor Islands, Protection Island, and Tatoosh Island. The most abundant breeding species are the Rhinoceros Auklet (60% of total) and the Glaucous-winged Gull (24% of total).

Seasonal distribution, abundance, and species composition are discussed according to region. Data for Swiftsure Bank are limited but indicate that it is typical for offshore waters of this coast. The Strait of Juan de Fuca, Outer and Inner regions, are especially important because of the large number of Common Murres present in the Summer and Fall (nearly 240,000 birds). The shoreline subregions of these regions are radically different than the open water. Large numbers of ducks, geese, gulls, alcids, and shorebirds are present east of Port Angeles to and including Discovery Bay. Jamestown has a particularly high density of waterfowl in Spring and Fall. Admiralty Inlet is important as a migration and local movement corridor between southern Puget Sound and the Strait of Juan de Fuca.

The Anacortes to Hale Passage and Georgia Strait--Eastern regions include many bays that are very important habitat for large numbers of Black Brant, scoters, and other waterfowl as well as Western Grebes. Padilla Bay is important habitat for Summer nonbreeding ducks. As many as 50,000 Dunlin as well as other shorebirds use Boundary Bay during migration.

Large numbers of scoters and other diving ducks, loons, grebes, and alcids are found in the Georgia Strait--Western region. Many birds are attracted to herring spawn in the Spring. Noteworthy concentrations of Oldsquaws. Common Murres, Marbled Murrelets, and Arctic Loons are found in the Winter.

The portion of Haro Strait within our study area has low numbers of birds primarily because it includes deep waters and small amount of shoreline. Rosario Strait is characterized by large numbers of feeding gulls, alcids, and cormorants. Numerous breeding and roosting sites are present in Rosario Strait.

The San Juan Islands-Northern Waters region has few nesting colonies and overall numbers of marine birds are low. The San Juan Islands-Interior Channels and Passages region also has low numbers, with Pelagic Cormorants, though concentrations of Glaucous-winged Gulls, and Rhinoceros Auklets are especially important in Summer.

The San Juan Islands-Interior Bays region is characterized by localized high Winter concentrations of diving ducks, Horned and Western Grebes, and Mew Gulls. Diversity is much higher than in the preceding two regions.

Active Pass is the most important feature in the Canadian Waters region. Large feeding flocks of 7,000 birds are frequently seen in Winter. Abundant species include Brandt's Cormorant, Arctic Loon, Common Murre, and Bonaparte's Gull.

Based on beached bird censuses, present marine bird mortality is low. The maximum rate observed is 1.47 dead birds/km/census.

I. INTRODUCTION

I-A. General Background

The Puget Sound region is a major habitat for migrant, winter resident, and breeding marine birds along the Pacific coast of North America. The variety of aquatic, shoreline, and estuarine environments here attract a wide variety of bird species and particularly represent a crucial link in suitable coastal habitat along the Pacific coast.

The increased oil tanker traffic into the Strait of Juan de Fuca and San Juan Islands area is a result of increased oil products consumption by the United States. It also results from the necessity of refining Alaskan crude oil. This continued need for oil trans-shipment and refining facilities has now made probable the establishment of such facilities at a location along the Strait of Juan de Fuca. In advance of such a decision, federal and state agencies have conducted literature reviews and field studies to establish baseline data on the natural resources of the region that may be affected by oil industry activity.

Despite the fact that birds are often the most obvious and dramatic casualties of oil spills, no adequate studies on avian distribution, abundance, and seasonal occurrence exist for the Puget Sound region. This, then, has precipitated the initiation of this NOAA (MESA-Puget Sound Project) investigation of marine birds.

The purpose of this investigation is to characterize the marine bird populations from the mouth of the Strait of Juan de Fuca, east to Admiralty Inlet and north to the United States-Canadian boundary, and identify significant marine bird habitats. The study objectives include determination of the seasonal distribution, abundance, and species composition of marine bird populations throughout the study area, identification of spatial and seasonal trends in abundance and distribution, identification of geographic areas of significant concentrations, and updating published marine bird distribution and abundance data for the region.

I-B. Previous Avifaunal Studies in the Region

Despite the region's easy accessibility, few intensive studies on marine birds have been conducted. Early observations are partially summarized in Dawson and Bowles (1909) and Jewett et al. (1953). Numerous short notes on the distribution of marine birds are published in the *Murrelet* and *Audubon Field Notes* (now *American Birds*) or as in Bakus (1966). Surveys and catalogues of Washington and British Columbia include Drent and Guiget (1961), Drent et al. (1964), Peters et al. (1978), Manuwal (1977), and Manuwal and Campbell (*in press*). A bibliography of Washington State birds was prepared by Alcorn (1972). A recent checklist of the birds of Washington State has been prepared by Mattocks et al. (1976). With the exception of unpublished waterfowl surveys conducted by the Washington Department of Game and the U.S. Fish and Wildlife Service, no intensive studies on the distribution and abundance of marine birds in the study area have been conducted. There are, however, several studies on the breeding biology of certain species.

Most research in northern Washington and southern British Columbia waters has been done on the Glaucous-winged Gull. These studies include those by Schultz (unpubl.), Vermeer (1963), Stout et al. (1969), Stout and Brass (1969), Thoresen and Galusha (1971), and Galusha and Stout (1977).

Research on the Black Oystercatcher comes primarily from Hartwick (1973) in British Columbia and Nysewander (1977) in Washington.

Cormorants have been studied by Van Tets (1959, 1965) in British Columbia. No studies have been conducted in Washington.

Pigeon Guillemots have been intensively studied by Thoresen and Booth (1958) in Washington and by Drent (1965) in British Columbia.

Rhinoceros Auklets were first intensively studied by Richardson (1961) on Protection Island. Populations were studied on Destruction Island (Leschner 1976), Protection Island (Wilson 1977), and Smith Island (Manuwal unpubl.) in Washington. Summers (1979) investigated a colony on Cleland Island, British Columbia.

This study's comprehensive field sampling has provided vast and unprecedented amounts of quantitative data. Few geographical areas of similar size have been studied as intensively during a similarly short period of time. The study has provided the first overall survey of all species and the varied localities and habitats of the entire region. As such, it represents a very large step in understanding the seasonal and geographical distribution of marine birds of the region and provides primary data to replace most sources available at this time. The secondary sources (see Salo 1975, Eaton 1975, Brittell et al. 1976, Lindstedt-Siva 1978) dealing with species, problems, and management of the region all reflect (and acknowledge) the lack of data then available and, essentially, resynthesize past and other secondary source publications. In some cases these contain outright errors of fact, many of which have been cited repeatedly in one secondary source after another.

We stress, however, that the brief time span of this study and limited frequency of sampling mean that the study only represents a first step in quantifying and characterizing the marine bird distribution and associations within the region. Refinement and expansion of our data base and interpretations are primary purposes of the second year's study. Beyond this, as in any field study, gathering and analyzing data inevitably leads to further questions.

II. STUDY AREA AND METHODS

To achieve the objectives of this study, various censusing techniques were utilized, as described in II-A, and the study area was divided into various regions (Figure 1) and subregions as necessary to facilitate the analysis and discussion of the seasonal marine bird populations.

II-A. Census Methods

Seabird censusing is affected by a virtually unlimited number of variables. Environmental conditions have significant effects on numbers of birds censused because they affect both the birds' behavior and their observability, as well as influencing the observer. There is considerable variation between observers in experience, visual acuity, and abilities to estimate flock size and distance. Bird behavior varies among species and by time and weather. Species observability and identifiability also vary greatly. Because of these variable observation limitations, our censuses in nearly all cases are minimum counts. Only rarely, if ever, do our counts represent exactly what is in the area surveyed, but most counts probably approach this level. Thus, our error is on the conservative side and all projections of numbers (see below) are necessarily understated. Our census methods closely parallel those developed and refined during the California and Alaska OCSEAP bird investigations. For pertinent discussion of assumptions and statistical treatments, see King (1970), Wiens et al. (1978), Briggs et al. (1978), and Dixon (1977).

Data from our aircraft and vessel censuses are probably somewhat more variable than similar data taken by Briggs et al. (1978) and Wiens et al. (1978) for several reasons. Compared to their essentially straight-line, open-water census tracks, many of our census segments were relatively short along shorelines and around islands. This increased effects of factors like tidal variation, complex geographical features, habitat diversity, and shadow and reflection contrast. Our aerial census segments were also often glare-affected and, because habitats and numbers varied greatly from one side of the aircraft to the other, we could not simply elect to omit glare-side censuses along shorelines as can be done over open water. In addition, our close-inshore censuses likely had many more birds observed.

Many of our censuses were done from shore locations. Data obtained on these censuses are probably more consistent and are unaffected by time pressure inherent in moving censuses, particularly from aircraft, where virtually instant perception, identification, and counting or estimating numbers are required.

We feel that observer errors tend to randomize out and, as noted above, that our methods, both in field data acquisition and in analysis, give conservative census counts and subsequently conservative projections. Our methods were consistent in all geographical subdivisions and our results, analysis, and ratings of subregions are comparable for purposes of this study.

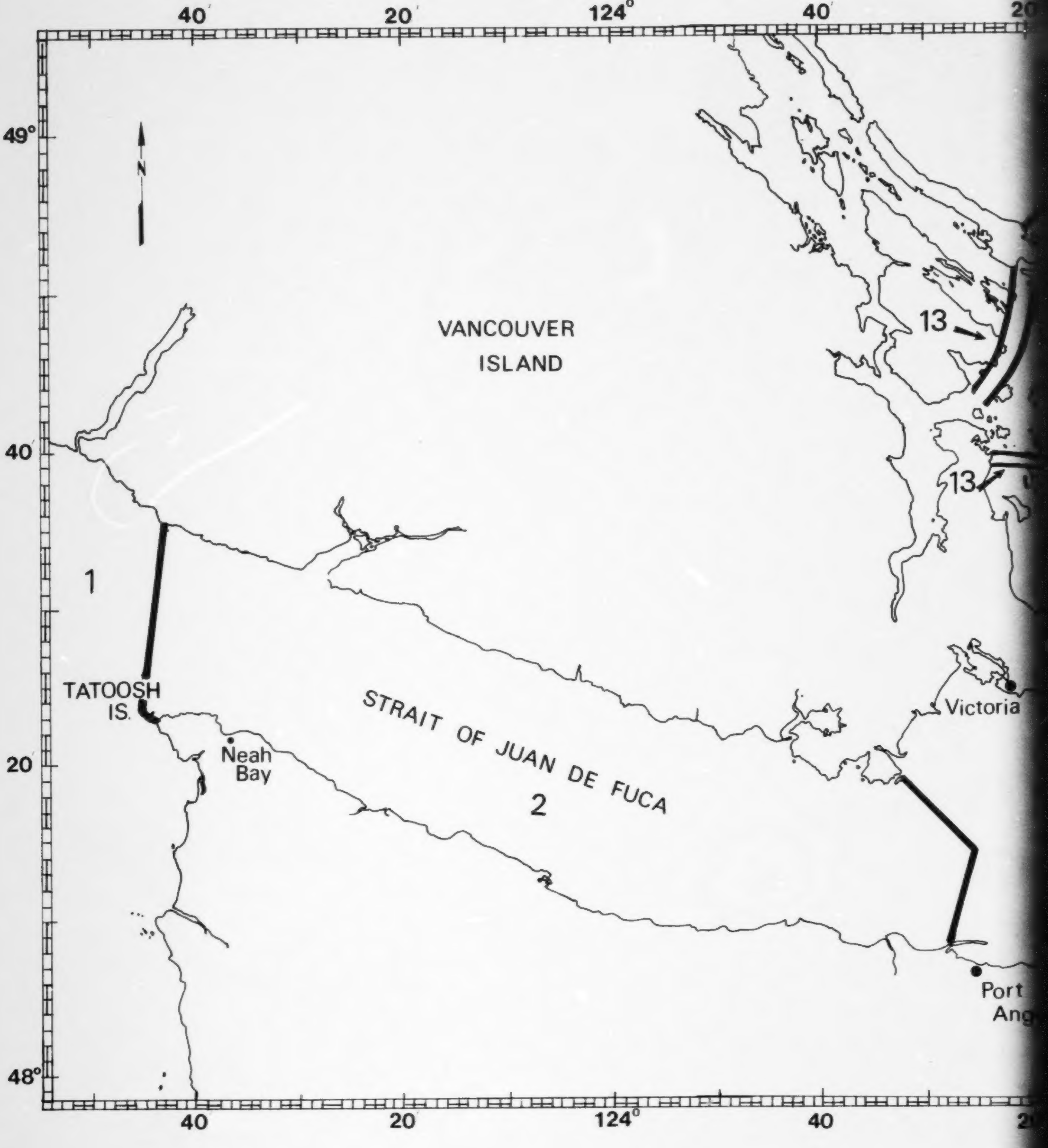

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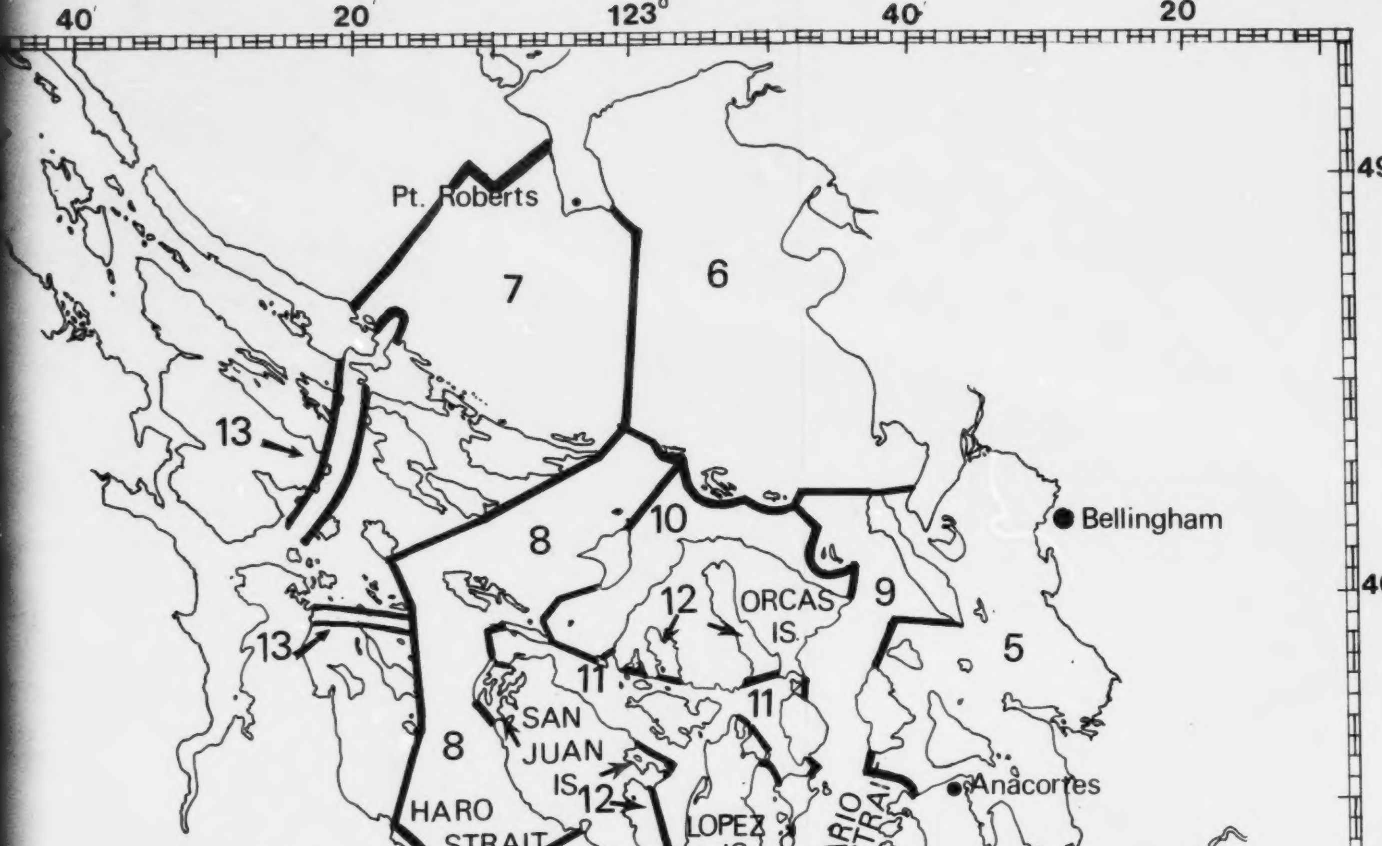
FIGURE 1. MAP OF STUDY AREA SHOWIN



P OF STUDY AREA SHOWING THE 13 REGIONS.

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II-A-1. Types of Censuses

All censuses were conducted at designated locations of known area or over designated routes. Census areas were selected (1) to sample known or likely areas of bird concentrations and (2) to sample all geographic regions and habitat types within the study area. Census points for these areas were selected to maximize coverage within the constraints of accessibility and time.

Census segments covered from moving vessels such as small boats, ferries, or aircraft are designed to sample habitat types. Almost all such segments are approximately 2 to 8 km long, though two long segments over the open waters of the Straits of Georgia and Juan de Fuca were 20 km and 96 km long, respectively.

In order to characterize habitats and accurately depict census locations, regions, and subregions, our census areas are classified in the following manner.

a. Bays and harbor censuses--Enclosed or nearly enclosed bodies of water. These censuses are conducted from shore locations, small boats, and aircraft.

b. Shoreline censuses--Along open shores of mainland or large islands adjacent to large bodies of water, with censusing from shore or from water looking toward shore from vessels or aircraft.

c. Small island and rock censuses--Small land units actually or potentially used by seabirds as nesting, roosting, or resting sites. Censused from aircraft or small vessels.

d. Open water censuses--Fixed-transect width counts over large bodies of water and at least 500 m from adjacent land areas. Censused from aircraft, small boats, or ferries.

While some censuses of small passages, estuaries, and bays covered virtually all the surface of the defined census area, not all birds present were observed even in these small areas; consequently, our censuses represent samples.

II-A-2. Observation Periods

We divided the year into seasons based on generalized seabird activity cycles within this region. "Spring" is April and May, the period when birds migrate through and into the study area. "Summer" is 1 June to 15 July when the population consists primarily of summer resident species, nonbreeding individuals of species nesting outside our region both to the north and in the southern hemisphere, and a small number of migrants. "Fall" is 16 July to 31 October, and includes the principal southward migration of birds summering to the north of our region and those species which nest here and move south for the winter. "Winter" is from 1 November until 30 March. There is much overlap between species and yearly variation in these seasons.

In 1978 we conducted 3,667 individual censuses over the four seasons (see Table 1). Nearly half of these were aerial census segments. The small number of Summer censuses reflects the short duration of this period. The frequencies of specific census techniques are outlined below.

Table 1. Seasonal Frequency of Census Techniques

	Season				
Census Technique	Spring	Summer	Fall	Winter	Total
Airplane	508	142	451	509	1,610
Beach Census	31	28	29	64	152
Beach Walk	38	33	41	70	182
Boat	89	22	58	107	276
Ferry	168	81	177	277	703
Point Census	152	79	166	191	588
Sea Watch	74	15	35	32	156
TOTAL	1,060	400	957	1,250	3,667

II-A-3. Point Census

This is a periodic census of all birds, flying or on the water, visible from designated shore locations. Using binoculars and telescope, censuses were conducted by a thorough, deliberate scanning of the area. Duplication of census areas (as in bays) was avoided by use of reference points.

Point censuses were used to sample bays and open shorelines (as at Cherry Point, Whidbey Island, and Point Roberts (Figure 2). The area covered was calculated from (1) the bird observability distance which was determined by the elevation of the observation location, (2) reference points checked from standard National Ocean Survey marine charts, and (3) observation conditions at the census site.

II-A-4. Sea Watch

A sea watch consists of counting all birds moving past a designated point as the observer watches in a fixed, predetermined direction. Direction of movement and standard bird and environmental data are recorded. Telescopes were used at most locations, though binoculars were used at Point Roberts where bird movements were predominantly close inshore. Census periods were of 30 or 60 min, primarily during hours from dawn for 2 to 3 hours, and for 2 to 3 hours before dark. The

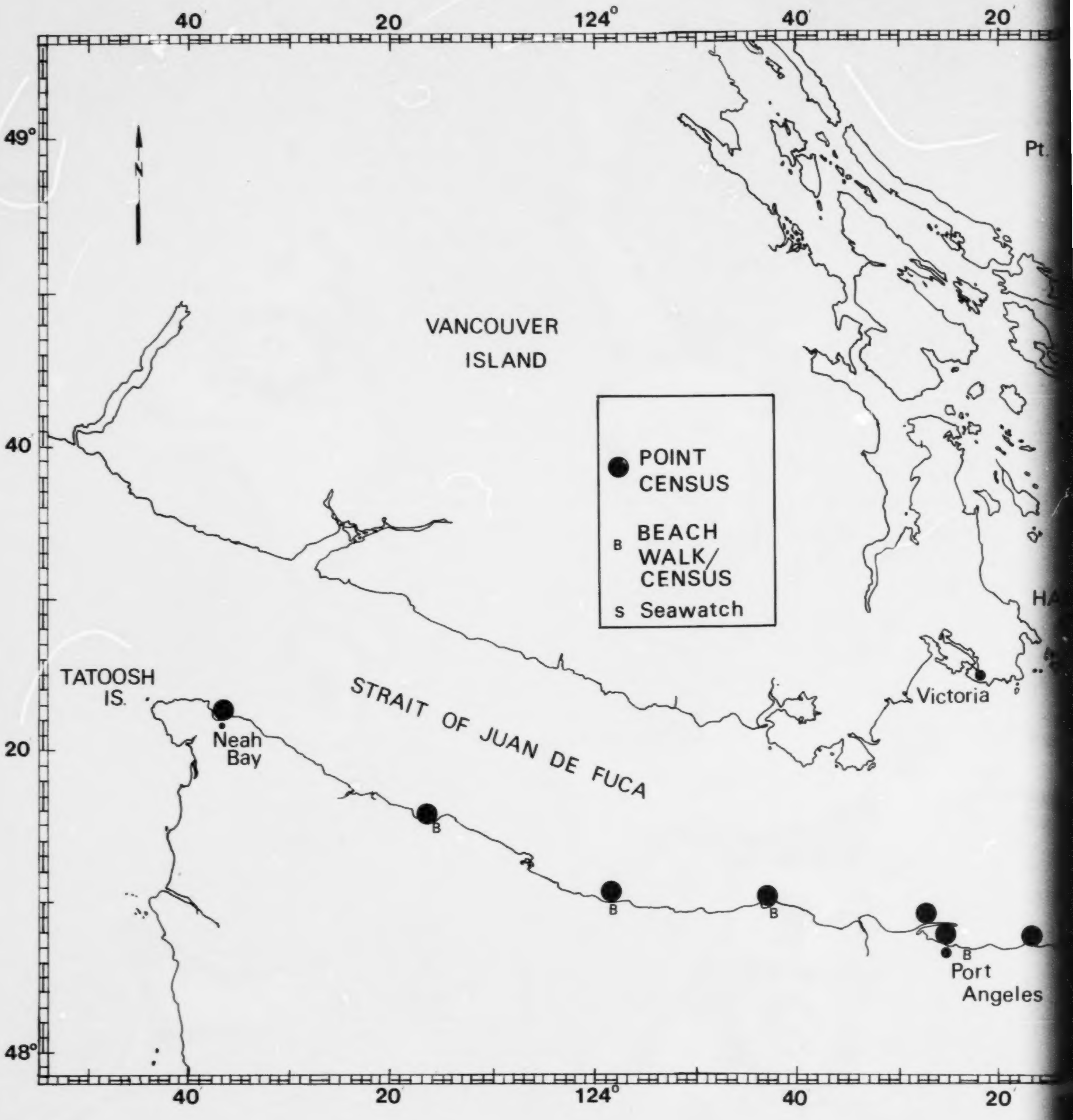

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FIGURE 2. MAP SHOWING LOCATIONS OF POINT CENSU

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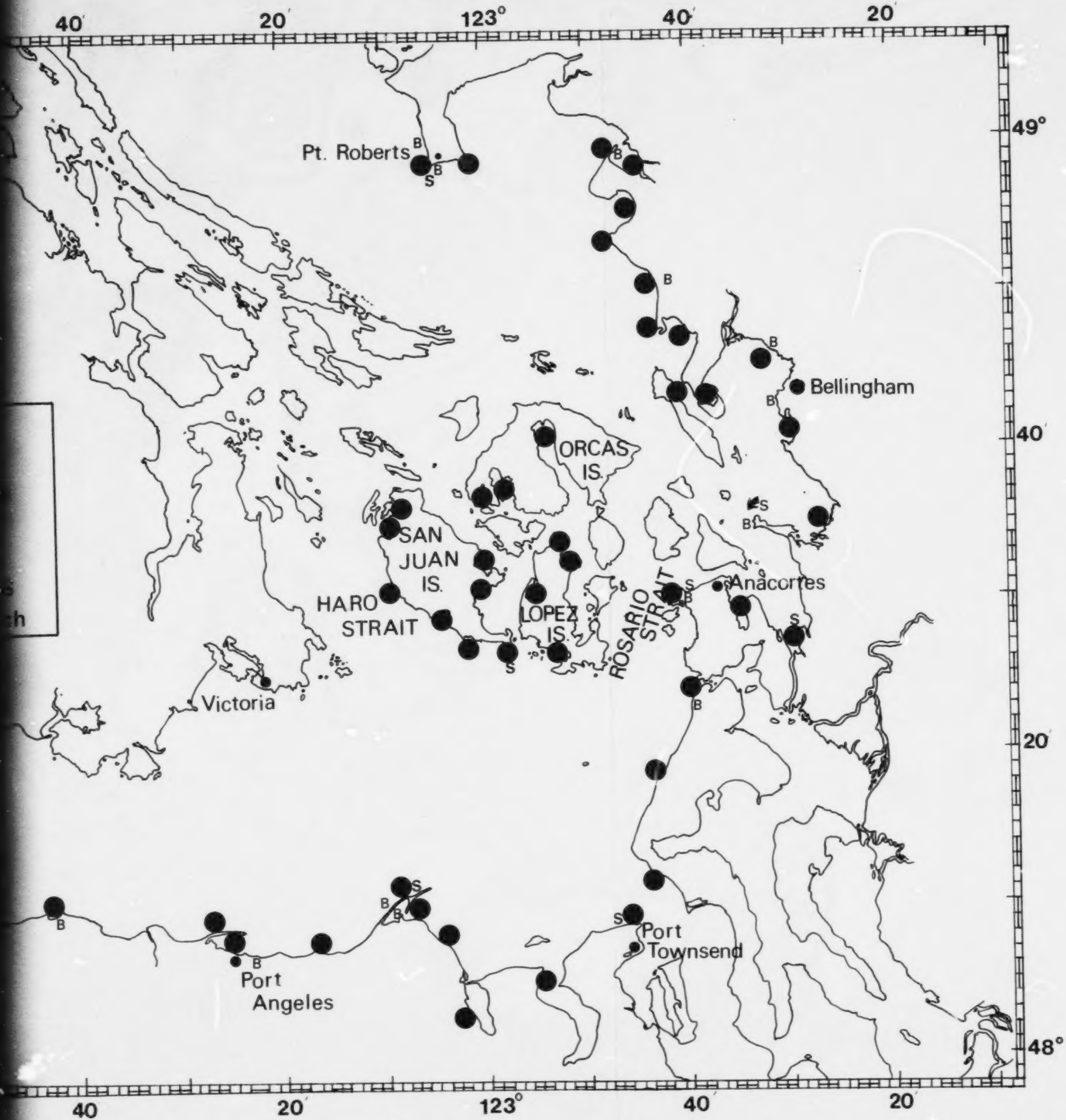

NG LOCATIONS OF POINT CENSUSES AND SEA WATCHES.

11/12

B

purpose of this type of census was to determine possible migration and daily movements. A single observer made observations in each census. Locations of Sea Watches are shown in Figure 2.

II-A-5. Beach Census

This is a count of all birds along a known length of beach, from approximately high tide line to 100 m offshore. Meaningful counts require censusing early in the day before birds are disturbed by humans and dogs. The purpose of a beach census is to provide samples of inshore populations along different shoreline habitat types. One observer on foot usually conducts each census. Beach census locations are given in Figure 2.

II-A-6. Dead Bird Censuses (Beach Walk)

Beach walks are censuses on foot along known lengths of beach, searching for dead birds from water's edge to upper tide levels. Species, age, sex, state of bird, cause of mortality, oiling, condition of water and beach, and disposition of bird were recorded when possible. Beach walks were usually conducted as the return leg of a live-bird Beach Census (above). Specimens were occasionally salvaged and deposited in the Burke Memorial Museum, University of Washington. In addition, dead birds were noted when observed on all moving censuses from small boats, ferries, and aircraft. Locations of Beach Walks are given in Figure 3.

II-A-7. Small Boats Census

Periodic in-motion censuses of open waters, shorelines, and small islands or rocks (colonies or roosts) were conducted from outboard-powered vessels under 7 m long, though privately financed chartered vessels of 15 to 30 m length were used on several occasions. Censuses from small vessels supplemented, and also occasionally duplicated, those done by aircraft or ferries.

II-A-8. Ferry Census

Census of open waters, passages, and along some shorelines were made monthly by experienced observers aboard ferries between Port Angeles and Victoria, B.C. (referred to below as Strait of Juan de Fuca ferry), Port Townsend and Keystone (Admiralty Inlet), Anacortes and Sidney, B.C. (San Juans), and Tsawwassen--Swartz Bay, B.C. (Georgia Strait). Binoculars were used to verify unaided eye sightings when necessary over a 500-meter transect width on one or both sides of the vessel. (This was determined and periodically calibrated by use of a simple range-finder adapted from Wiens et al. 1978). The observer normally censused a 90° arc from bow to side, on the side offering the best observation conditions at the start of the trip, with the opposite side covered on the return trip. Both sides (180° arc) were occasionally censused during the periods of low bird abundance. Census locations were set to provide separate open water and shoreline habitat data. Ferry censuses were usually done on a round-trip basis.

II-A-9. Aircraft Census

Monthly censuses of birds were made from a Cessna 172 aircraft flying about 60 m above the surface at a speed of about 148 km/h (80 kt/h). One observer on each side surveyed a transect width of about 60 m by unaided eye, covering a 40° arc from about 40° below horizontal to about 10° above vertical (see Figure 4). This assumes an uncensused "blind area" beneath the aircraft about 10 m wide. Aerial transect routes are shown in Figure 5.

II-B. Region Descriptions

For analysis, we divided the study area into regions (Figure 1, and Table 1, Appendix 1) and, in most cases, subregions that allow concentrations and variations in populations to be shown in greater detail. In some cases these divisions may vary from those used in other studies. While this may be reflected in the calculation of density and vulnerability values, we feel the variations are minor and that our divisions are realistic.

Since we have few censuses in Canadian waters, some regions and subregions do not include Canadian shoreline or open water areas (Figure 1). Areas east of Whidbey Island are not a part of the study area, nor are waters of Puget Sound south of Admiralty Inlet.

II-B-1. Region 1.--Swiftsure Bank (waters off the mouth of the Strait of Juan de Fuca).

This is an offshore area used for species composition and population comparisons with the Strait Juan de Fuca regions and those farther east. We define it as essentially between 48°15' and 48°35'N, and 124°45' and 125°05'W, and includes part of Swiftsure Bank and outer continental shelf waters from about 60 to about 320 m depth.

II-B-2. Region 2.--Strait of Juan de Fuca, Outer

This large region is bounded on the west by a line from Cape Flattery to Carmanah Point, Vancouver Island, and on the east by a line from Port Angeles to Race Rocks, B.C. (Figure 1). It includes the waters of up to 300 m depth in midstrait and small shallow bays and estuaries such as Neah Bay, Clallam Bay, and Crescent Bay. Shorelines are otherwise characterized by rocky types with extensive kelp beds. Port San Juan, Sooke Harbor and Basin, and Becher Bay, B.C., are within the region but were not censused.

II-B-3. Region 3.--Strait of Juan de Fuca, Inner

This region contains the eastern portion of the Strait of Juan de Fuca (Figure 1). Important subregions include Port Angeles Bay, Dungeness Bay and Harbor, Sequim Bay, Discovery Bay, and extensive open shorelines including Ediz Hook and Dungeness Spit which are the largest of a number of accreted gravel spits protecting embayments. A variety of other shoreline types are present, including rocky shorelines, mixed fine

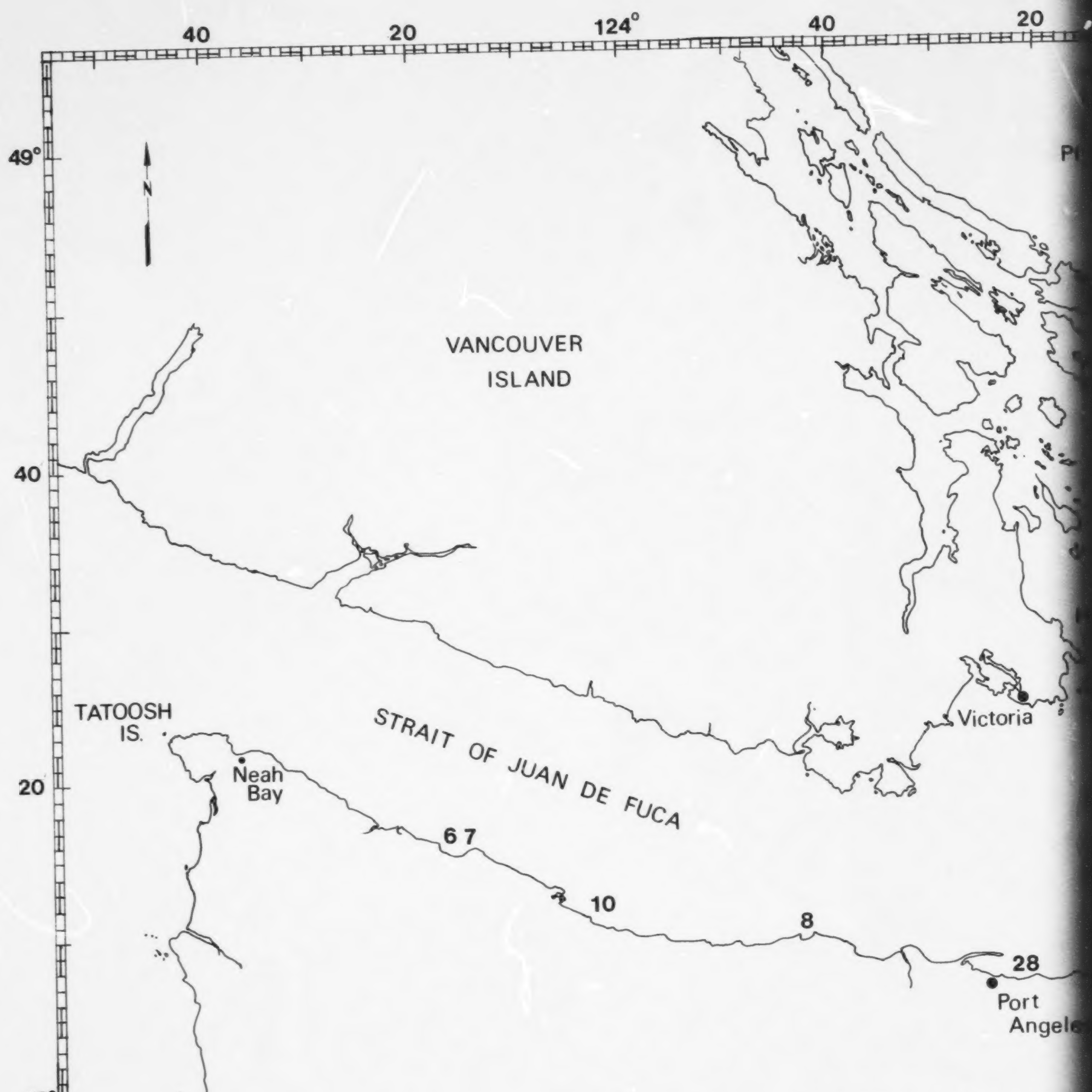

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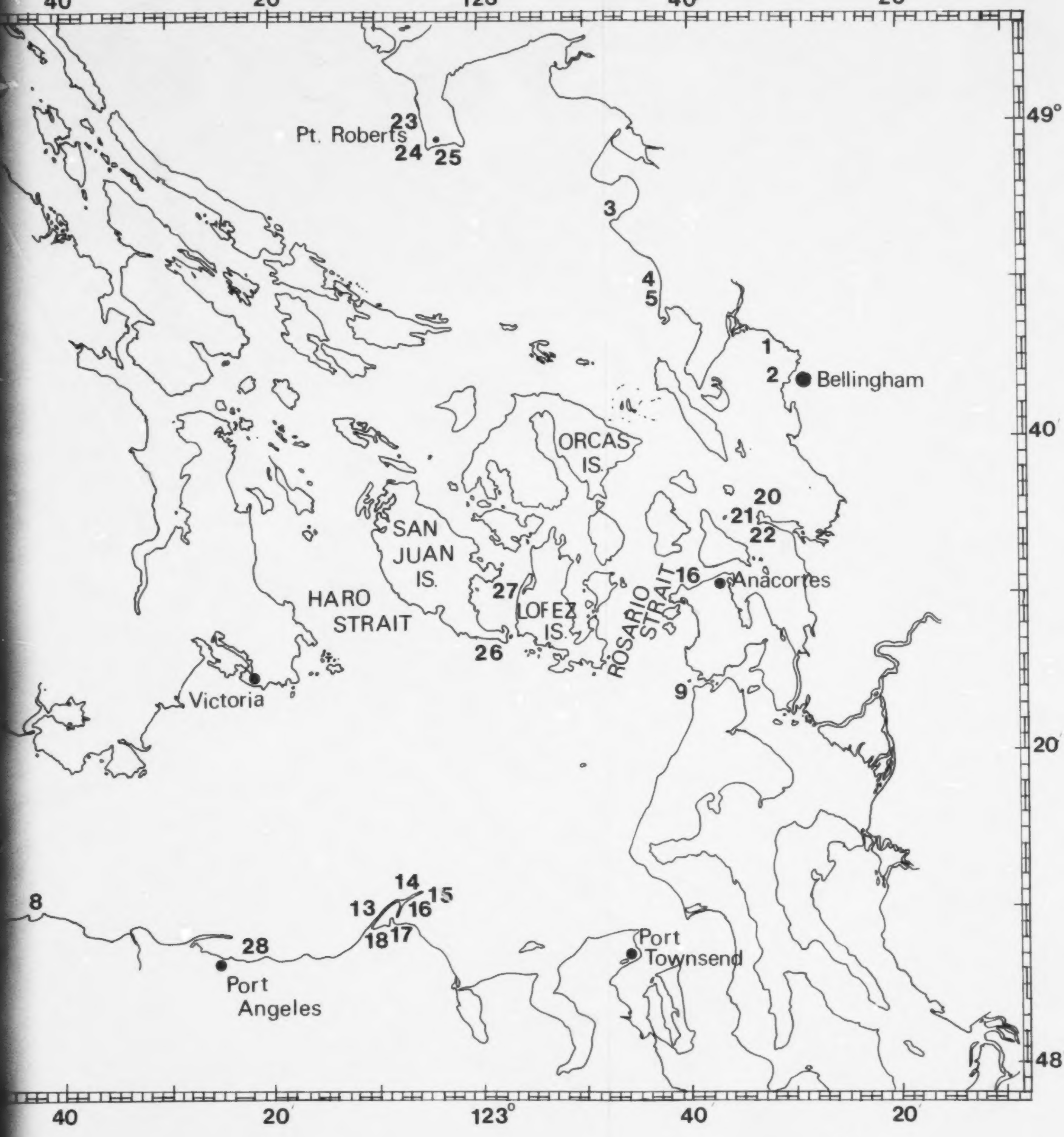
FIGURE 3. MAP SHOWING LOCATIONS O



MAP SHOWING LOCATIONS OF BEACH WALKS.

15/16 B

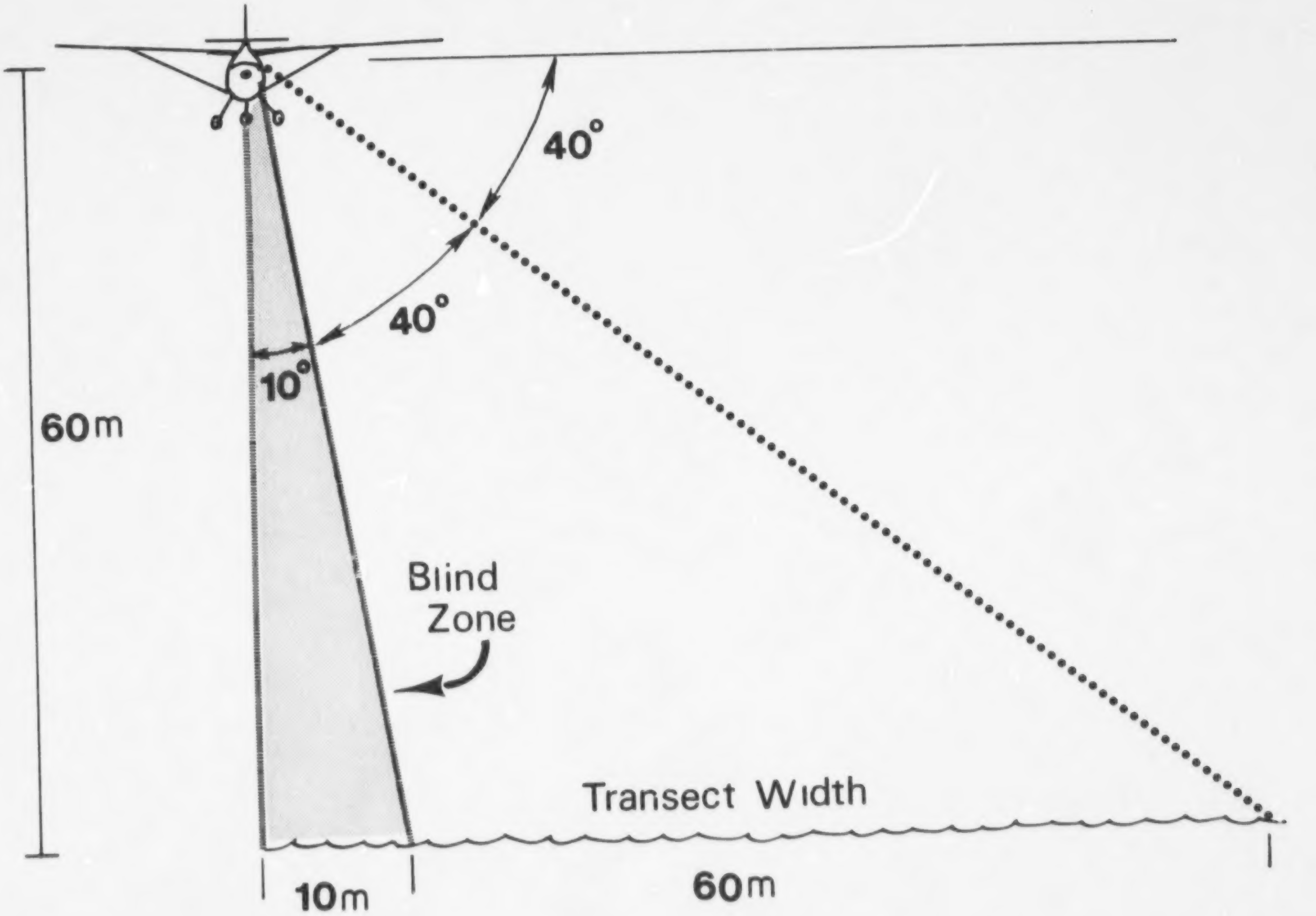


FIGURE 4. DIAGRAMMATIC REPRESENTATION OF AERIAL CENSUS TRANSECT WIDTH.

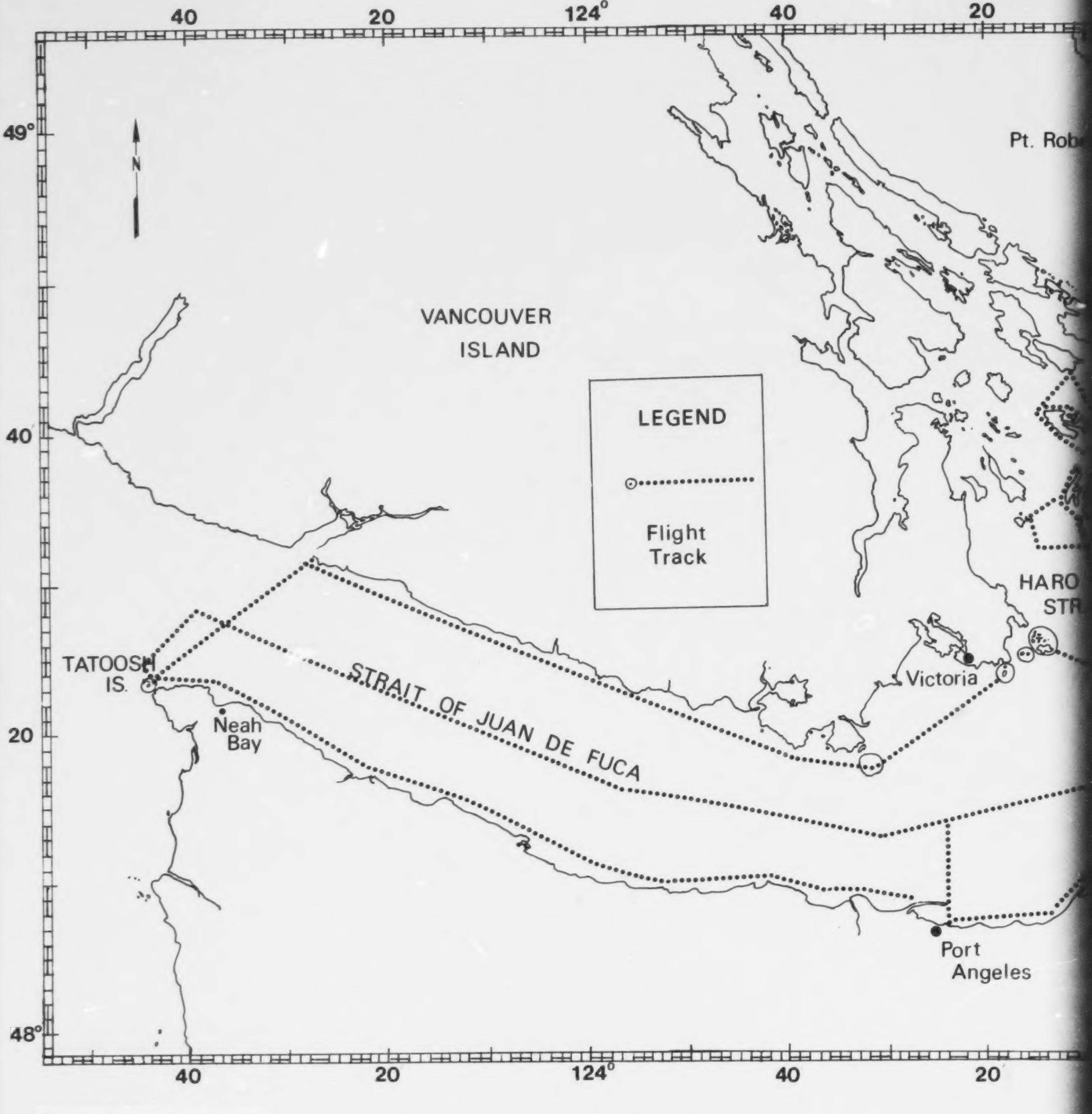


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FIGURE 5. MAP OF AERIAL SURVEY ROUTE FLOW

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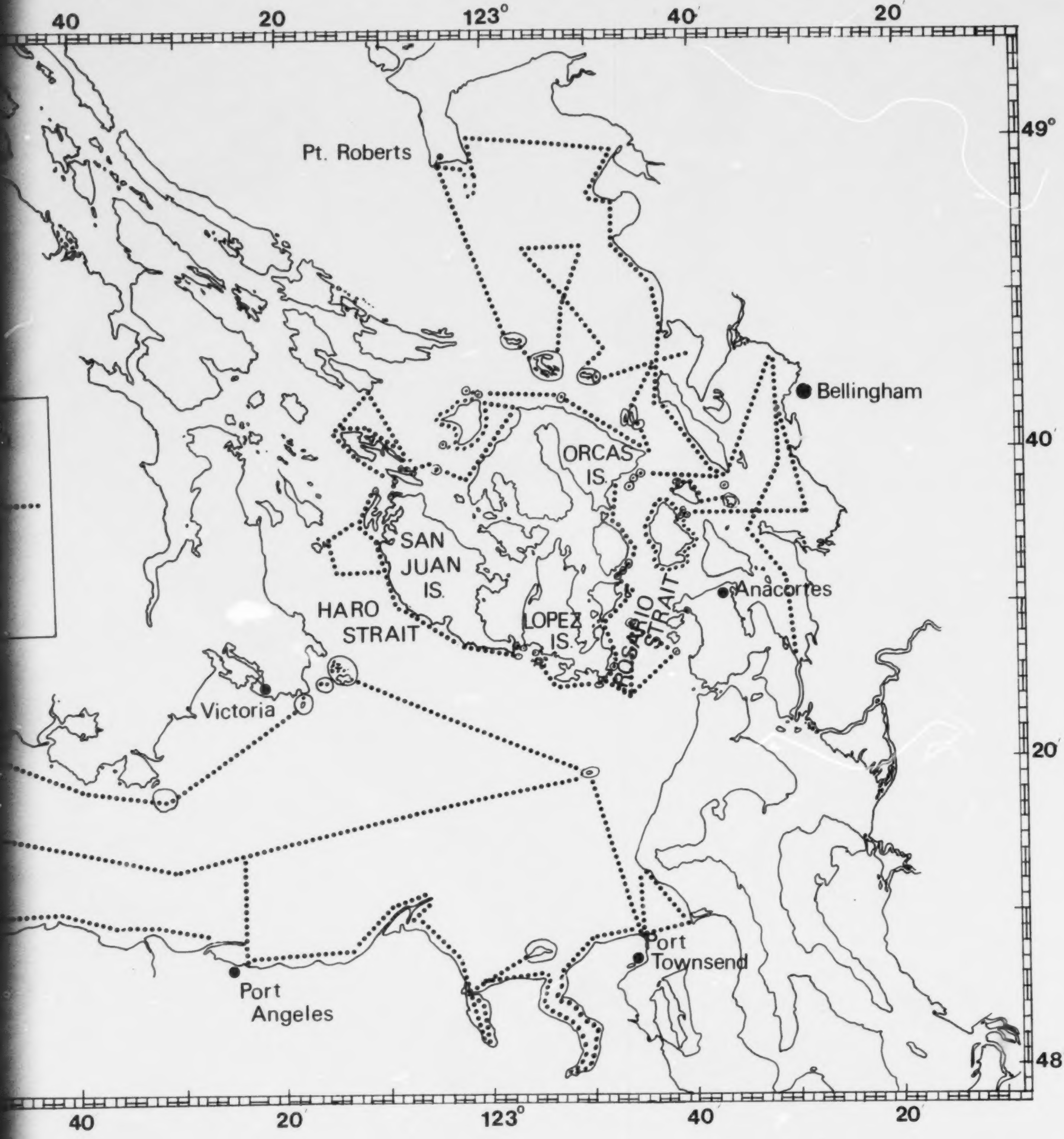

AP OF AERIAL SURVEY ROUTE FLOWN IN 1978.

19/20 B

beaches, and particularly on the southern shorelines of the San Juans, continuous rock strata formations.

II-B-4. Region 4.--Admiralty Inlet

This important foraging area is the turbulent channel exchanging waters between Puget Sound and Strait of Juan de Fuca. Shorelines included in our study are limited in length but are primarily gravel and mixed types. Kelp beds are extensive.

II-B-5. Region 5.--Inner Whatcom and Skagit County Waters

This region lies east of Rosario Strait, and includes as subregions Bellingham and Guemes channels, Fidalgo, Padilla, Samish, and Bellingham bays, and Hale Pass (Figure 1). The bays in particular represent important shallow estuarine habitats and significant areas for birds. Sandy, rocky, and rock-strata shoreline types are all found within this region, as well as man-made dikes, breakwaters, and piers which form a greater part of the shoreline component than in other regions. Very large eelgrass beds are found in the shallow bays, whereas kelp and other algal communities are present in other shore and intertidal types. This region also has considerable amounts of urban, agricultural, and industrial effluents, along with effects of human disturbance and hunting. In general, this region has been more affected by human presence than other areas within the study area.

II-B-6. Region 6.--Eastern Georgia Strait

The study area essentially ends at the United States-Canada boundary, and our coverage and data do not include shallow and highly productive Boundary Bay, B.C., which is a significant feature adjacent to this study region and biologically part of it (Figure 1). Shorelines are primarily sandy, mixed and cobble, with bluffs backing beaches along part of the eastern shoreline. Eelgrass and kelp communities are present within the region.

II-B-7. Region 7.--Western Georgia Strait

This deepwater region is influenced by low salinity/high turbidity surface waters resulting from Fraser River runoff. Offshore water depths range to over 200 m. Shorelines sampled in our study were essentially mixed gravel and sand, with associated kelp, and the shallow mud/sand bay with eelgrass at Tsawwassen. Productive waters of Roberts Bank and Sturgeon Bank immediately to the north along the British Columbia foreshore are not included in our study.

II-B-8. Region 8.--Haro Strait

We have divided Haro Strait into northern and southern subregions by a line from Turn Point, Stuart Island, to Fairfax Point, Moresby Island, B.C. (Figure 1). Adjacent shorelines of the San Juan Islands are included within these regions, but not shorelines on the Canadian side. Haro

Strait itself is up to 300 m deep. Shores within our study boundaries are primarily rock strata, with one sizeable shallow-shelf, low-beach component at Waldron Island.

II-B-9. Region 9.--Rosario Strait

We divided Rosario Strait into northern, central, and southern subregions, using a line between Point Lawrence and Boulder Reef and a line from Pointer Island, near Thatcher Pass, to Shannon Point (Figure 1). Rock strata/kelp shorelines, islands, and reefs predominate, and shallow shelves are found only in Burrows Bay and along the east side of Lopez and Decatur Islands. Much of Rosario Strait is from 40 to 100 m deep.

II-B-10. Region 10.--San Juan Islands, Northern Waters

This region is the northern tier of the San Juan Islands (Figure 1). A subregion comprising President Channel is separated from our "Northern Areas" subregion by a line from Terrill beach, Orcas Island, to Fossil Bay, Sucia Island. Offshore water depths range from 60 to 100 m. Shorelines are primarily rock strata, with adjacent kelp communities.

II-B-11. Region 11.--San Juan Islands, Passages and Channels

We placed channels and passages within the San Juan Islands into a "region," though there are differences among them (Figure 1). The region includes Speiden Channel, Wasp Pass, Upright Channel, Harney Channel, Obstruction Pass, Thatcher Pass, and San Juan Channel which we divided into northern and southern subregions by a line between Friday Harbor and southern Point George, Shaw Island. Shallow shelves along shorelines are relatively narrow. Offshore water depths generally range between 40 and 100 m. Strong tidal currents are apparent in a number of locations. Kelp and other algal communities are widespread.

II-B-12. Region 12.--San Juan Islands, Inner Bays and Sounds

Small bays or shallow areas adjacent to deep passages in the San Juans are grouped into a specific region (Figure 1). The Mosquito Pass-Roche Harbor complex, Friday Harbor, Griffin Bay, Fisherman Bay, Swift, Shoal and Blind bays, Lopez Sound, Deer Harbor, West Sound, and the shallow northend of East Sound are included.

II-B-13. Region 13.--Canadian Gulf Islands

This region includes Canadian waters surveyed as a part of ferry censuses of adjacent American waters (Figure 1). It is comprised primarily of deep passages and relatively open waters and does not reflect a shoreline data component except in two relatively highly productive areas. These are the shoreline on the east side of Sidney Spit (included in the "Sidney" subregion) and the Active Pass subregion. Shorelines within the region are varied, including shallow, mixed shore types and gravel spits, but are often of continuous rock strata. Very strong tidal exchange occurs, especially in Active Pass.

II-C. Field Observations

Sampling consisted of counting or estimating numbers of individual seabirds (and marine mammals) of all species observed by age, sex, or colorphase where feasible. Count data from aircraft or vessels were recorded on tape cassettes and transcribed at earliest convenience onto census tabulation forms. Tape recording of observations made daily fieldwork more efficient in: (1) quantity of data collected per trip, requiring less time to census a given area; (2) greater accuracy and completeness of sightings; and (3) maximized use of observer travel time and resources. Fixed location shore censuses were usually tape recorded, though some observers recorded directly onto field record sheets.

Environmental conditions (wind direction on 8-point compass scale, cloud cover in oktas, sea state on Beaufort scale, and notes on precipitation or observation conditions) were recorded by the observer, as well as local starting and ending times. In aerial censuses, these data were recorded by a "navigator" who also called out transect numbers to observers and assisted the pilot.

Censusing accuracy was enhanced by use of observers experienced with the species involved, the region, and with censusing methods. A very limited number of observers conducted all moving transects or shoreline censuses from aircraft, small boats, or ferries. Consistent censusing techniques and observer quality, employed within a narrow range of suitable observation and environmental conditions, were objectives at all times.

All birds observed were identified to the species level whenever possible, as well as by age and sex. Species names were recoded on field forms and later on computer code sheets in a four-letter coded form derived from the species names, i.e., Glaucous-winged Gull--GWGU, Northern Shoveler--NOSH, Marbled Murrelet--MAMU. If species-specific identification was not possible, then the bird was coded at the next higher level of classification, i.e., large Cormorant (Brandt's/Double-crested)--LACO, gull--GULL, small Loon (Arctic/Red-throated)--SMLO. Subspecific identification was not attempted in general, as this was not an object of the project nor is it possible to make such determinations in the field. Persons interested in such refinements of identifications must refer to appropriate taxonomic works.

Throughout this study and report, species and family vernacular names for the most part follow those used in the AOU (1957) Checklist of North American Birds and its subsequent supplements (1973 and 1976) and those found in Robbins et al. (1966) and Peterson (1961).

II-D. Breeding Bird Surveys

Data on breeding bird colonies were obtained by circumnavigating by boat 138 suitable islands in the study area during June, 1978. Estimates were made from counts of birds at the colony-sites. This technique is suitable for surface-nesting species, but hole-nesters require more time to count burrows or determine occupation of crevices. Only on Tatoosh and Smith Islands were land surveys made of burrows and nests. Species such as the Tufted Puffin and Rhinoceros Auklet require this additional effort. Our data on these species for Protection and Smith Islands were obtained from Wilson (1977) and Manuwal and Campbell (in press). Total estimates for the entire study area for the Pigeon Guillemot and Marbled Murrelet were obtained by the standard aerial and point censuses, since these species are not easily counted around their nest-sites. The projected total numbers for each subregion were then summed to obtain the regional total.

II-E. Data Preparation

All tapes are transcribed as soon as possible after returning from the field. All data sources are summarized with species-age, sex-totals prepared, and the respective environmental observations classified for each site. After summarizing, the data are coded onto key-punching sheets. Data thus coded include number by species, age, and sex, the four-letter species code, environmental data (cloud cover, wind direction, and Beaufort scale), observer(s), time start and elapsed time, date, station/segment, and observation platform/area surveyed. Local time and date are converted to Greenwich Mean Time and also recorded. At this time, the Julian Date and census number are assigned, and after a visual check of the coding sheets they are given to the key-punching service for data card preparation.

After the cards are punched and verified they are then listed, and the listings are carefully checked for any errors. At this point, the data cards are read onto a disk file in the computer center and transferred to a storage tape. Here, an editing program is run on the data set checking for appropriate character ranges in each field. After errors are corrected on disk using a screen and edit package, the two cross-reference programs are run on the data set. One cross-reference program matches our field species code to the NOAA/NODC (National Oceanic Data Center) twelve digit species code and fills in the code number in the appropriate fields. Any discrepancies are given as error messages and they are corrected at this time. The second cross-reference program matches the station/segment-platform/area surveyed code with various appropriate location data--latitude, longitude, habitat types, segment length and area, and water depth. Any discrepancies are given as error messages and they are corrected at this time. After these operations are completed, a listing of the data set is obtained and again visually inspected for errors. The data sets are managed in monthly packages. After all editing is completed the data sets are transmitted to the NODC for archiving. Data sets may be obtained by contacting Dr. James B. Ridon, MESA Data Coordinator, NOAA/EDIS/NODC, 2001 Wisconsin Ave., N.W., Washington, D.C. 20235

II-F. Data Analysis

During the 1978 survey period, 43,353 records were generated on five record types. The first two types contain all relevant location, observer, and environmental data. The third record type contains the species data, with each card representing the total observed of each species at a site or segment. The fourth record type contains data on dead birds when they are observed at a site. The fifth type is text with noncodable data such as observations of feeding flocks, roosting areas, and marine mammals. These five record types represent the package of data collected at a given site or segment, with a unique set generated each time the station is censused.

All record types contain the File Identification number, record type number, and site/segment code. Thus the cards for a given census are uniquely linked. In addition to this linkage, we assigned every site/segment to a region and subregion (see Table 1, Appendix I) with a site/segment occurring in only one region/subregion. For analysis, the data sets are sorted first by date, period (Spring, Summer, Fall, and Winter), and region/subregion. Within the last breakdown the sites are further sorted as belonging to open water (i.e., Strait of Juan de Fuca or open water of Bellingham Bay) or shoreline (i.e., Dungeness Spit, Cherry Point). An area (subregion) such as Bellingham or Sequim bays contains both open water areas such as in the center of the bay and shoreline areas. Other subregions may contain only shoreline or open water habitats (see Table 1, Appendix I).

II-F-1. Regions and Subregions

Subregions were created to best describe geographical or biological units although sometimes arbitrarily (see II-B). Within each subregion it is biologically necessary to distinguish between open "deeper" water habitats and shoreline "shallow" water habitats. These areas were often determined from NOAA navigational charts but tempered by field observations. Generally, shoreline water habitats are those areas next to shore and less than 20 m in depth.

For the open water and shoreline components of each subregion a value representing the total surface area (in km^2) of each was calculated again from NOAA navigational charts. Each region's total area is the sum of its subregions (see Table 1, Appendix I). Thus the total of all open water and shoreline areas is known for the entire study area and its parts. These totals for the parts of the subregion are used to project the total number of birds in each family observed in the appropriate subregion component. These projections are made from the calculated density for each family in each habitat type. To combine open water and shoreline is highly misleading. For example, a species in high density along the shoreline of the Strait of Juan de Fuca-Outer, a relatively small area, would project inflated numbers if extended to the over 1,800 km^2 of the open water area.

Several censuses may take place within each subregion habitat component, open water and shoreline, during each seasonal period. The shoreline area of the Jamestown subregion is a good example, as it is censused from a small boat, the airplane, and by a point census. Each of these census technique--segment/stations--samples a different part of the surface area, and the total area surveyed in each case--segment/station--is different. In only a few instances is the area sampled the same as or equal to the area for which projections are made.

II-F-2. Bird Species Observability

During a given observation period an area may have several census types which are often repeated in order to calculate the density of each family. In light of the exceedingly difficult problem of equivalence between census techniques, we are taking all our data at face value. Thus, in most cases, our counts are underestimates of each species present. Obviously, some species such as Glaucous-winged Gulls are very visible even in unsettled weather and are seldom missed, but some diving species are more easily overlooked by the observer(s). At point censuses, in particular, these difficulties are mitigated by the skills of the observer.

II-F-3. Marine Bird Density

It is of prime importance to project the expected total number of birds present in each family in each subregion, and to do this the Mean Weighted Density (MWD_f) of each family is calculated. This is given by equation (1),

$$MWD_f = \sum_{i=1}^{n} \sum_{j=1}^{n} (n_{ij})(a_j/\Sigma a_j)(1/a_j) \qquad (1)$$

where n_{ij} is the total number of the $\underline{i}^{th}$ species observed in the $\underline{j}^{th}$ census (segment/station), a_j is the area sampled by the $\underline{j}^{th}$ census (segment/station), and Σa_j the total of areas of all censuses performed, including those for which no species of a particular family were observed. The term $(a_j/\Sigma a_j)$ is a factor which weights the contribution of a census in determining the MWD. Thus a census that covers only 0.1 km^2 will contribute less to the MWD than one that covers ten times that area. However, it is seen that (1) reduces to (2)

$$MWD_f = \sum_{i=1}^{n} \sum_{j=1}^{n} (n_{ij}/\Sigma a_j) \qquad (2)$$

These MWD_f values for each family, period, and subregion are contained in Appendix IV.

From the MWD_f values it is possible to project the total number of birds in each family probably present in the open water and shoreline components of each subregion (3) during each period

$$PT_f = (MWD_f)\ (A_k) \qquad (3)$$

where A_k is the subregion area made up by shoreline or open water habitats. The subregion and region projected totals for each family (PT_f) are obtained by summing the appropriate species PTs.

Unfortunately, densities and projected totals for species and families are in themselves important but of limited value in trying to make management decisions relating to a variety of topics; in this case the potential for the appearance of oil on the water surface normally and naturally occupied by birds. Clearly, there is an intuitive feeling that the loss of a loon is of greater consequence than the loss of a Glaucous-winged Gull, or the loss of a Western Grebe as compared to a Bufflehead. To quantify these qualitative and quantitative features of species we referred to an "Oil Vulnerability Index" created by King and Sanger (MS) for use in Alaska. However, after careful examination of this system, it became apparent an index system was needed for this study of the birds of the Washington marine environments. To this end we created a Bird Oil Index (BOI).

II-F-4. Bird Oil Index

The BOI is an attempt to quantify the various aspects of behavior, biology, and distribution and abundance as related to exposure to uncontrolled oil on the water surface. This index is intended for use with all marine birds of Washington. Details for the assignment of category ranking and calculation of each species' BOI value are presented in Appendix II. In short, there are three major components of the BOI, each equally contributing on a scale of zero to ten, with the BOI value for any species potentially running from 0 to 1,000.

The first component deals with the habits of individual birds as they relate to the vulnerability of the species to spilled oil (reacting, escape behavior, flocking on water, nesting concentration, and feeding (foraging) specialization). The second relates to the total population and its vulnerability to oil (population size, reproductive capacity, breeding dispersion, winter dispersion, and seasonal exposure to waters on which spilled oil could appear). And the third component relates the significance of our populations to the total population and the effects spilled oil could have during the four seasons.

The family BOI_f score for each habitat type, each season, and for each subregion, are given in Appendix IV. The calculation of the family BOI_f value is given by

$$BOI_f = \sum_{i=1}^{n} BOI_i \; A_k \sum_{j=1}^{n} (n_{ij}/\Sigma a_j) \qquad (4)$$

where BOI_i is the BOI for the $\underline{i}^{th}$ species of the given family. The other terms are as above.

As a further tool to evaluate various bodies of water it is helpful to know the number of BOI units that are present in each km^2. This is not a density figure in the literal sense, as we are not talking about birds per unit area but their BOI value per km^2 as given in (5).

$$BOI_f/km^2 = BOI_f/A_k \qquad (5)$$

BOI/km^2 is an expression of the projected "importance-vulnerability" per km^2. The appropriate subregion and regional totals are the sums of the BOI_f values (Appendix V).

II-F-5. Rating of Subregions

Each subregion was rated in two ways, one on the basis of its BOI (total) value score and second on its BOI/km^2 score (Tables 1 and 2, Appendix VI). These two ratings were then averaged, producing an average rating for each subregion, thus adjusting for variations in subregion size. These average ratings were then ranked on a five point scale and were then adjusted upwards to take into account either the presence of marine bird breeding colonies or of roosting areas (Table 8). The two techniques allow easy presentation and interpretation of otherwise large and hard-to-digest sets of data.

These subregional ratings are for guidance in assessing potential vulnerability of bird populations to oil spills. For considerations of other impacts of short-run local disturbances, the seasonal rating may be generally suitable. For consideration of impacts of permanent habitat alteration or large-scale, long-term disturbances, the highest, most critical rating is applicable.

II-F-6. Avian Taxonomic Considerations

Our analysis is made at the family level throughout this report, except where particular species/phenomena warrant further discussion. As a good rule, families not only represent taxonomic units but ecological units as well. Clearly, grebes are ecologically distinct from loons and alcids. Likewise, cormorants are distinct from gulls, herons, etc. Possibly only in the ducks and geese would subfamily divisions be warranted. Generally with only minor exceptions, the family level analysis presented here is ecologically and behaviorally sound.

III. RESULTS AND DISCUSSION

III-A. General

Our census results represent "point-in-time" samples. No attempt is made in this analysis to allow for variations in observability of species or for such factors as the percentage of total diving birds that are actually feeding: diving bird numbers are relatively underestimated compared to surface-feeding birds. Census numbers represent minimum numbers present at a given time, and mean numbers used for the characterizations below understate numbers, especially the maximum numbers of extremely mobile feeders like fish-eaters, which may move considerable distances within short periods of time.

Data from several aerial censuses replicated within brief periods showed great variation. In the OCSEAP California Bight study, Briggs et al. (1978) found similar variation in their flight data. Likewise, return-trip replication of censuses from ferries showed considerable variation, even on transects repeated within 30 to 40 minutes. Some variations are due to changing environmental conditions and their effects on observations. Some may be due to disturbance created by the first census path. Much of the variation is probably due to the fact that birds are very mobile and often patchily distributed, particularly when feeding.

Factors which influenced the numbers observed in estuaries and bays included stage of tide and amount of intertidal areas exposed, effects of wind, flooding by rivers (which introduced large quantities of turbid, low-salinity waters), and freezing conditions which in a few cases covered prime salt edge habitat with ice pans 300± m wide. The effect of waterfowl hunting was readily apparent in many cases. Birds were almost totally displaced from prime habitats during hunting hours. Whether the birds used the areas at night and what the net effect is on birds and habitats from this displacement is unknown. Ducks quickly reoccupy previously heavily hunted areas at the end of the hunting season.

The time of the census also affected number observed. Foraging areas have highest densities during the day, whereas roost areas have greater numbers at night. Stage of tide in channels and tide-rip areas, patchiness and variability of location of prey species are other factors. Very frequent and extremely detailed sampling would be required to quantify the effects of these factors. However, some of these effects will be discussed with the regional accounts section.

During 1978, a total of 79 species of birds were observed on transects or other census locations (Appendix III).

III-B. Survey of Breeding Marine Birds

Marine birds are found breeding throughout most of the shoreline and island habitat of the study area. Most species, however, are concentrated on 35 islands in the San Juan Islands, Smith and Minor Islands, Protection

Island, and Tatoosh Island. Approximately 92% of a total 29,600 pairs of 12 species nest in these areas (Table 2, see Figures 6 through 12 for locations of breeding colonies.

III-C. Regional Account of Breeding Birds

The locations and numbers of all breeding species, as of the end of 1978, are presented in Table 2. Omissions of totals for any species from given regions and subregions indicate a lack of their currently known breeding there. Pigeon Guillemots and Marbled Murrelets are widely dispersed nesting species, and they cannot be censused by the same techniques used for others. In fact, a nest of the Marbled Murrelet in Washington has never been found. Therefore numbers of these species nesting are projected from all regular census data (Table 2). The other nesting species were censused by on-site counts.

III-C-1. Outer Strait of Juan de Fuca (Region 2)

Important breeding colony sites are at Tatoosh Island and Seal and Sail Rocks (Table 2, Figure 6). The bird community on Tatoosh Island is typical of other outer coastal islands which have Storm-Petrels, murrelets, Tufted Puffins, and Cassin's Auklets. Storm-Petrels, murrelets, and Cassin's Auklets do not breed elsewhere in the study area.

Seal and Sail Rocks typify many colony-sites farther eastward in the Strait of Juan de Fuca in having Glaucous-winged Gulls, Pelagic Cormorants, Tufted Puffins, and Pigeon Guillemots as major components of the community. Tufted Puffins, however, have been reduced or exterminated from many of their previous colony-sites.

No other major colony sites are found in Region 2. Pigeon Guillemots, Marbled Murrelets, and Black Oystercatchers are present in low densities along the entire coastline of Region 2. There may also be a few isolated nests of Glaucous-winged Gulls and Pelagic Cormorants.

III-C-2. Inner Strait of Juan de Fuca (Region 3)

Breeding birds are concentrated on Protection Island (19,137 pairs) in the south, Smith and Minor Islands (846 pairs) in the eastern mid-section (Figures 6 and 7), and six islands off the south shore of Lopez Island (1,500 pairs, Table 2). Protection Island is the most significant colony site in the region, since its 19,137 pairs of six species is 82% of the 23,500 pairs of birds in the region (Table 2). The Rhinoceros Auklet is by far the most abundant nesting species in the region (Table 2). In fact, all the Rhinoceros Auklets in the study area nest in Regions 2 and 3. Considering all the study area, Protection Island also has very large numbers of Pelagic Cormorants, Glaucous-winged Gulls, Pigeon Guillemots, and a significant number of Tufted Puffins.

		Region/Subregion Number	Island Number[1]	SPECIES												Island Total[2]	Regional Total
				Fork-tailed Storm-Petrel[2]	Leach's Storm-Petrel[2]	Double-crested Cormorant[2]	Pelagic Cormorant[2]	Black Oyster-catcher[2]	Glaucous-winged Gull[2]	Common Murre[2]	Pigeon Guillemot[2,3]	Marbled Murrelet[2,3]	Cassin's Auklet[2]	Rhinoceros Auklet[2]	Tufted Puffin[2]		
Region	Swiftsure Bank	01--															
Subregion	Swiftsure Bank	0101															
	Regional Total																
Region	Strait of Juan de Fuca--Outer	02--															
Subregion	Strait of Juan de Fuca--Outer	0201										+[4]					
"	Vancouver Island[6]	0202									-[5]	-					
"	Cape Flattery	0203									(8)	+					
	Tatoosh Island			100	500		200	4	1,000	100	40		+	100	150	2,194	
"	Neah Bay	0204															
"	Neah Bay to Clallam Bay	0205										+					
	Seal and Sail Rocks						20	+	15		+				25	60	
"	Clallam Bay	0206									(2)	+					
"	Clallam Bay to Crescent Bay	0207									(50)	+					
"	Crescent Bay	0208									(1)	+					
"	Crescent Bay to Ediz Hook	0209									(100)	+					
	Regional Total			100	500		220	4+	1,015	100	(190+)	+	+	100	175		2,404+
Region	Strait of Juan de Fuca--Inner	03--															
Subregion	Strait of Juan de Fuca--Inner	0301									(130)	(70)					
"	Ediz Hook	0302									(+)	(+)					
"	Port Angeles	0303									(3)						
	Port Angeles Bay						40										
"	Voice of America	0304									(100)	(150)					
"	Dungeness Spit	0305									(20)	(9)					
"	Dungeness Bay/Harbor	0306									(50)	(3)					
"	Jamestown	0307									(280)						
"	Sequiam Bay	0308									(20)						
"	Miller Peninsula	0309									(40)						
"	Protection Island	0310									(870)						
	Protection Island						295	4	1,500		180			17,108	50	19,137	

Table 2. Regional, Subregional and Island Summary of Breeding Marine Bird Populations in the Study Area in 1978

				SPECIES													
		Region/Subregion Number	Island Number[1]	Fork-tailed Storm-Petrel[2]	Leach's Storm-Petrel[2]	Double-crested Cormorant[2]	Pelagic Cormorant[2]	Black Oyster-catcher[2]	Glaucous-winged Gull[2]	Common Murre[2]	Pigeon Guillemot[2,3]	Marbled Murrelet[2,3]	Cassin's Auklet[2]	Rhinoceros Auklet[2]	Tufted Puffin[2]	Island Total[2]	Regional Total
Subregion	Discovery Bay	0311									(30)						
"	Quimper Peninsula	0312									-	-					
"	Whidbey Island	0313									(8)						
"	Smith Island	0314															
	Smith and Minor Islands						100	6	110		30			600	+	846+	
"	Deception Pass	0315									(15)	(8)					
"	Lopez Island (south shore)	0316									(280)	(80)					
	Castle Island		1				1				30					31	
	Coleville Island		2			50	80	1	1,000		30				1	1,162	
	Hall Island		3				12	1	250		6					269	
	Long Island		4					8	10							18	
	Mummy Rocks		5						25							25	
	Whale Rocks		6					1	5							6	
"	San Juan Island (south shore)	0317															
"	Victoria, Vancouver Island[6]	0318									-	-					
	Regional Total					50	528	21	2,900		(1,868+)	(320+)		17,708	(51+)		23,446+
Region	Admiralty Inlet	04--															
Subregion	Admiralty Inlet	0401									(25)	(10)					
	Regional Total										(25)	(10)					35
Region	Anacortes to Hale Passage	05--															
Subregion	Bellingham Channel	0501									(130)	(190)					
	Viti Rocks		7			30	80	1	390		1					502	
	Eliza Rock		8					3			1					4	
"	Guemes Channel	0502									+	+					
"	Fidalgo Bay	0503									10						
"	Padilla Bay	0504							500		(40)	+					
"	Samish Bay	0505									(20)	+					
"	Bellingham Bay	0506							80		(65)	+					
"	Hale Passage	0507									(10)	(40)					
	Regional Total					30	80	4	970		(275+)	(230+)					1,589+

Table 2. Continued...

		Region/Subregion Number	Island Number[1]	Fork-tailed Storm-Petrel[2]	Leach's Storm-Petrel[2]	Double-crested Cormorant[2]	Pelagic Cormorant[2]	Black Oyster-catcher[2]	Glaucous-winged Gull[2]	Common Murre[2]	Pigeon Guillemot[2,3]	Marbled Murrelet[2,3]	Cassin's Auklet[2]	Rhinoceros Auklet[2]	Tufted Puffin[2]	Island Total[2]	Regional Total
									SPECIES								
Region	**Georgia Strait--Eastern**	06--															
Subregion	Lummi Bay	0601										(9)					
"	Cherry Point	0602									(4)	(2)					
"	Birch Bay	0603									(1)	(+)					
"	Semiahmoo Spit	0604										(12)					
"	Drayton Harbor	0605				20			10		+						
"	Boundary Bay	0606															
"	San Juan Islands-Northern Tier	0607									(200)	(6)					
	Matia Island		9								50					50	
	Patos Island		10						20		+					20+	
	Puffin Island		11					1	350		140					491	-
	Sucia Island		14								310					310	
"	Georgia Strait	0608									(130)						
	Regional Total					20		1	380		(635+)	(29+)					1,065+
Region	**Georgia Strait--Western**	07--															
Subregion	Pt. Roberts	0701							20		(5)	(40)					
"	Tsawwassen Bay	0702															
"	Georgia Strait	0703															
	Regional Total								20		(5)	(40)					65
Region	**Haro Strait**	08--															
Subregion	Northern Haro Strait	0801									(280)	(3)					
"	Bare Island		12				50	1	120						2	173	
	Cactus Island		13					1			20					21	
	Satellite Island		15					1			+					+	
	Skipjack Island		16						75		20					95	
"	Southern Haro Strait	0802									(60)						
	Regional Total						50	3	195		(380+)	(3)			2		633+
Region	**Rosario Strait**	09--															
Subregion	Southern Rosario Strait	0901									(7)	(50)					
	Bird Rocks		17			90		+	320							410+	
	Williamson Rocks		18			10	70	1	350		2			?	?	433+	
"	Central Rosario Strait	0902									(3)	(1)					
	No. Peapod Island		19					1	220		2					223	
	So. Peapod Island		20					1	85		2					88	
	Pointed Island		21						20		+					20+	

Table 2. Continued...

		Region/Subregion Number	Island Number[1]	SPECIES												Island Total[2]	Regional Total
				Fork-tailed Storm-Petrel[2]	Leach's Storm-Petrel[2]	Double-crested Cormorant[2]	Pelagic Cormorant[2]	Black Oyster-catcher[2]	Glaucous-winged Gull[2]	Common Murre[2]	Pigeon Guillemot[2,3]	Marbled Murrelet[2,3]	Cassin's Auklet[2]	Rhinoceros Auklet[2]	Tufted Puffin[2]		
Subregion	Northern Rosario Strait	0903									(20)	(50)					
	Lummi Island		22								+					+	
	So. Sister Island		23			2	11	1	130							145	
	Middle Sister Island		24					1	20							23	
	No. Sister Island		25					2	410		3					415	
	Regional Total					92	81	7+	1,555		(31+)	(101)		?	?		1,867
Region	San Juan Islands--Northern Waters	10--															
Subregion	President Channel	1001									(60)	(170)					
	Flattop Island		26								20					20	
	Gull Rock		27						100							100	
	Waldron Island		28								2					2	
	White Rock		29					+	10		13					23+	
"	Northern Areas	1002										(6)					
	Regional Total							+	110		(60)	(176)					346
Region	San Juan Islands--Interior Channels and Passages	11--															
Subregion	Spelden Channel	1101									(1)						
	Sentinal Island		30								+					+	
"	Northern San Juan Channel	1102									(1)						
"	Southern San Juan Channel	1103										(6)					
	Goose Island		33						60							60	
"	Wasp Pass	1104									-	-					
	Low Island		31					1			2					3	
"	Upright Channel	1105										(2)					
"	Harney Channel	1106									(41)	(3)					
	Willow Island		32						4								
"	Obstruction Pass	1107									-	-					
"	Thatcher Pass	1108										(+)					
	Regional Total							1	64		(45+)	(11+)					121+

Table 2. Continued...

SPECIES

		Region/Subregion Number	Island Number[1]	Fork-tailed Storm-Petrel[2]	Leach's Storm-Petrel[2]	Double-crested Cormorant[2]	Pelagic Cormorant[2]	Black Oyster-catcher[2]	Glaucous-winged Gull[2]	Common Murre[2]	Pigeon Guillemot[2,3]	Marbled Murrelet[2,3]	Cassin's Auklet[2]	Rhinoceros Auklet[2]	Tufted Puffin[2]	Island Total[2]	Regional Total
Region	San Juan Islands-- Interior Bays	12--															
Subregion	Mosquito/Roche Complex	1201									(30)						
"	Friday Harbor	1202															
"	Griffin Bay	1203									-	-					
"	Fisherman Bay	1205									-	-					
"	Swiftsure/Shoal Bays	1206									-	-					
	Flower Island		34						33		10					43	
"	Deer Harbor	1207									-	-					
"	West Sound	1208									-	-					
"	East Sound	1209									-	-					
"	Lopez Sound	1210									-	-					
	Regional Total								33		(40)						73
Region	Canadian Waters[6]	13--															
Subregion	Active Pass	1301									(9)						
"	Canadian Gulf Islands	1302									(15)	(7)					
"	Sidney Approach	1303									(170)	(170)					
	Regional Total										(194)	(177)					371
	Total Individuals										3,748	1,097					
	Total Pairs			100	500	192	959	41	7,242	100	1,874[7]	549[7]	+	17,808	228		29,593
	%			<1	2	1	3	<1	24	<1	6	2	+	60	1		

[1] Islands are numbered as they appear in Figure 7.
[2] Numbers refer to breeding pairs obtained from colony censuses.
[3] Numbers shown in parenthesis are of the projected individuals derived from standard censuses in Summer 1978: Pigeon Guillemot and Marbled Murrelet only.
[4] Known to be present in small numbers.
[5] Data are not available.
[6] Breeding colonies, if present, were not censused by on-site surveys as in U.S. Waters.
[7] Arbitrarily determined as half of projected individuals.

Table 2. Continued...

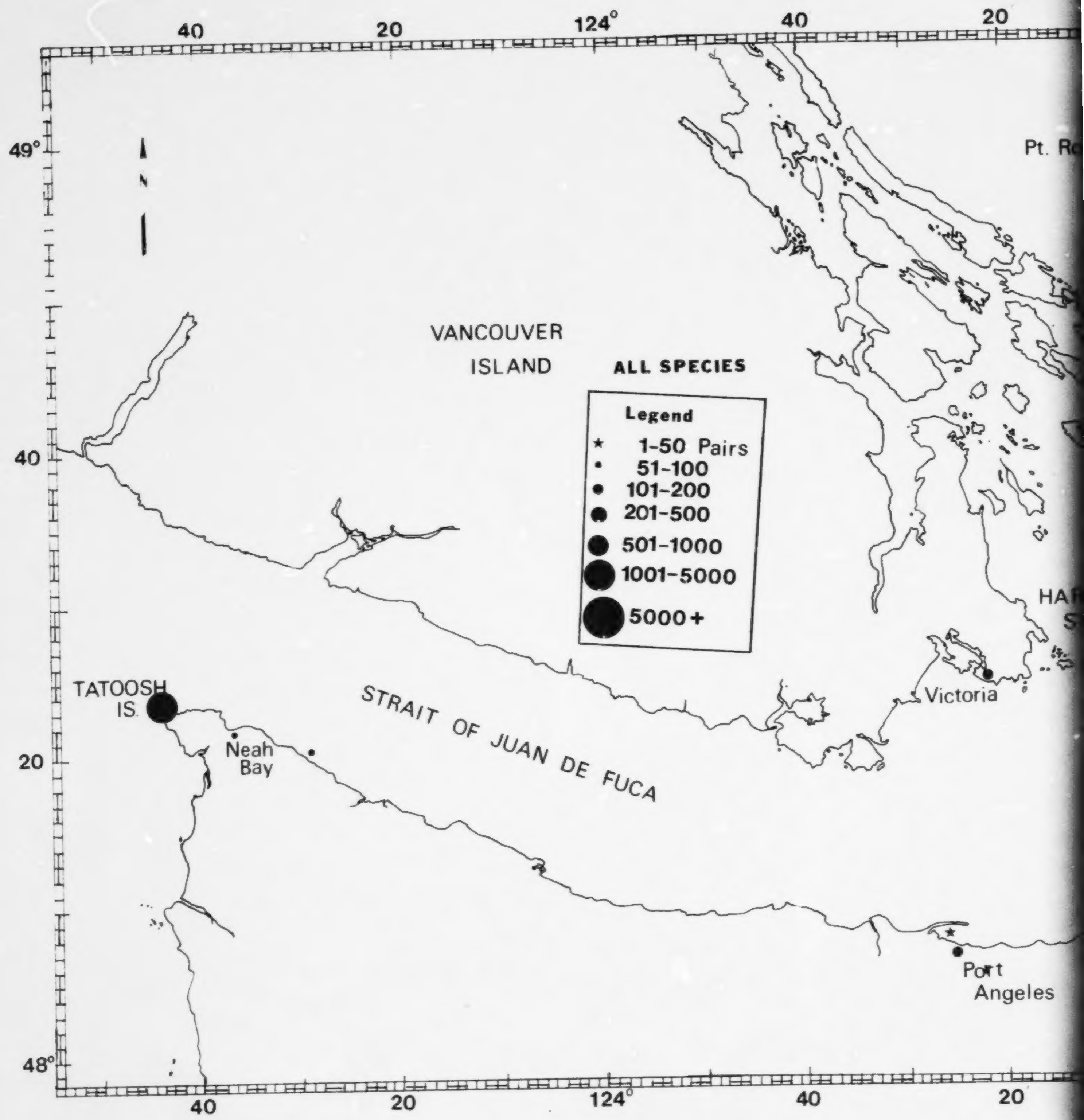

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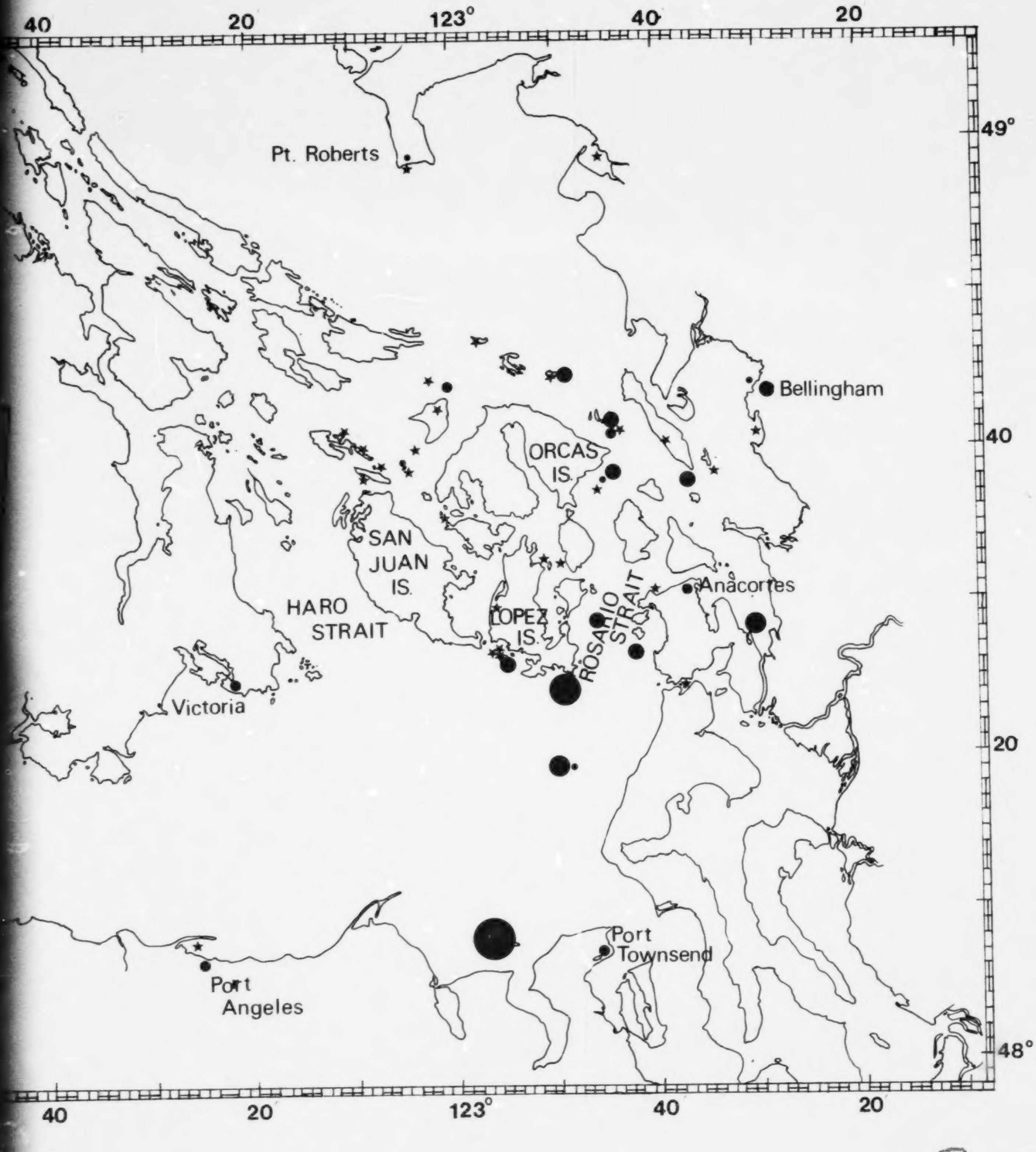
FIGURE 6. MAP OF MAJOR MARINE BIRD BREE



B

OF MAJOR MARINE BIRD BREEDING COLONIES.

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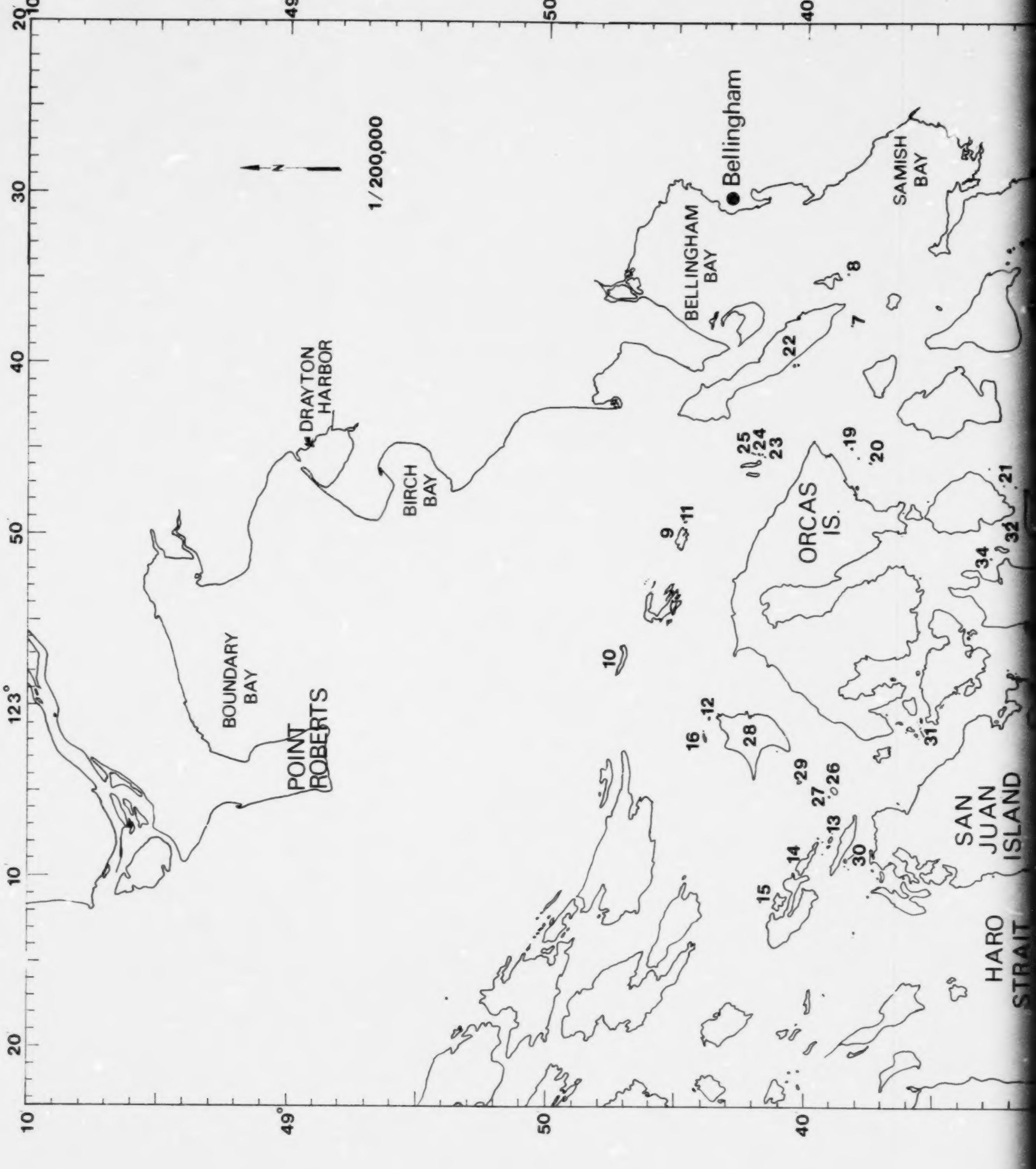

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FIGURE 7. MAP OF COLONY SITES IN THE SAN JUAN ISLANDS.

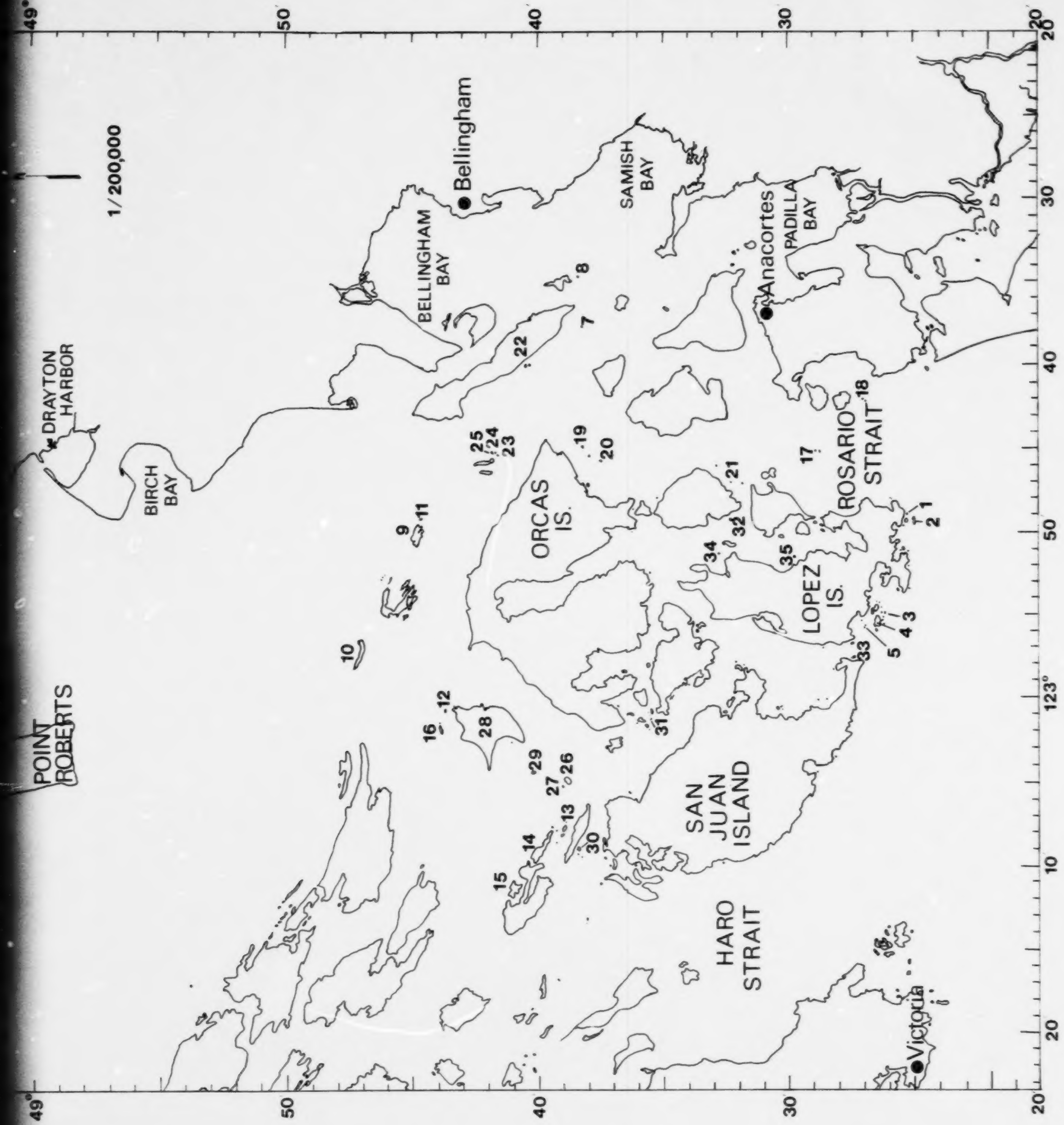

FIGURE 7. MAP OF COLONY SITES IN THE SAN JUAN ISLANDS.

39/40

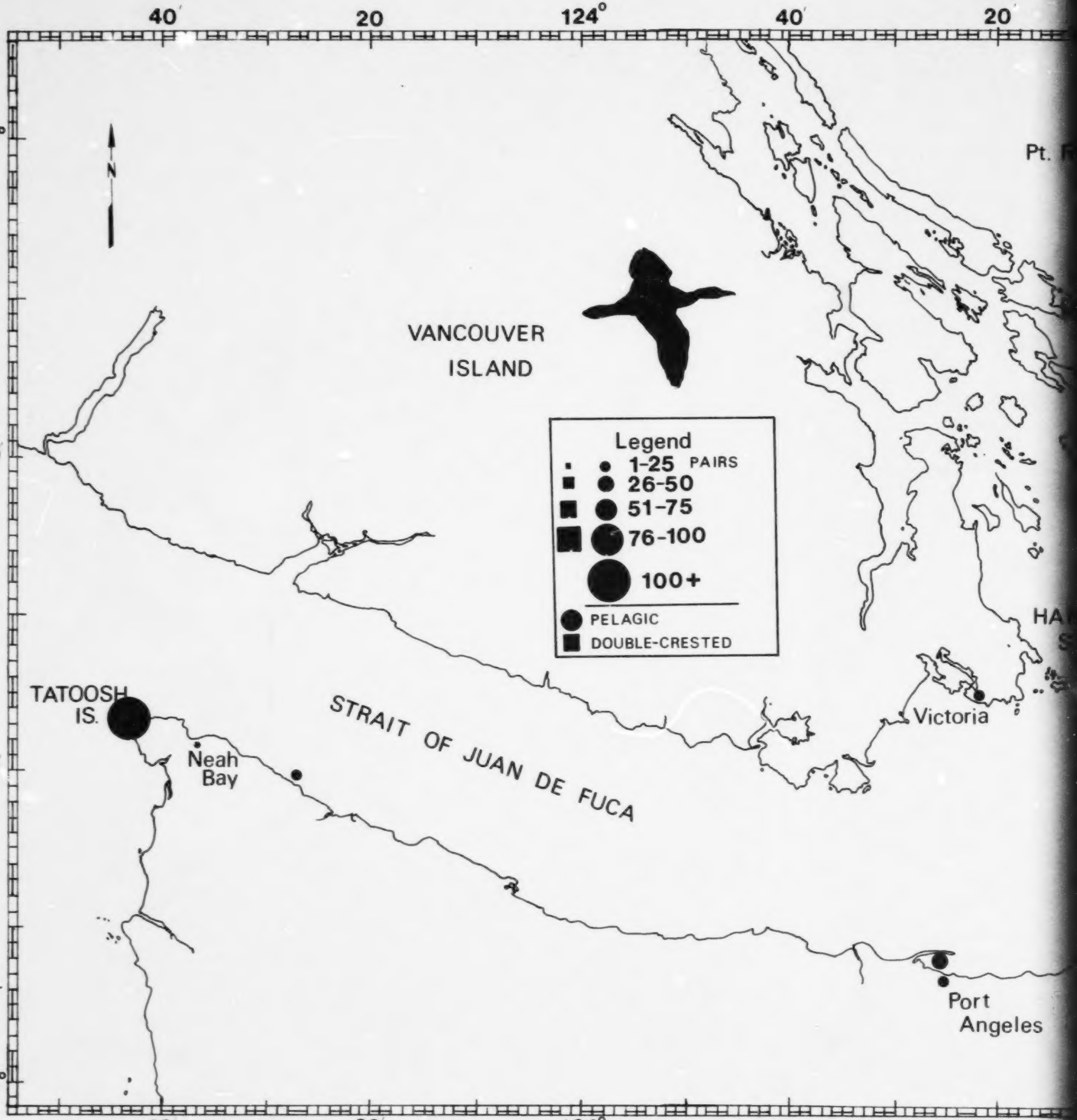

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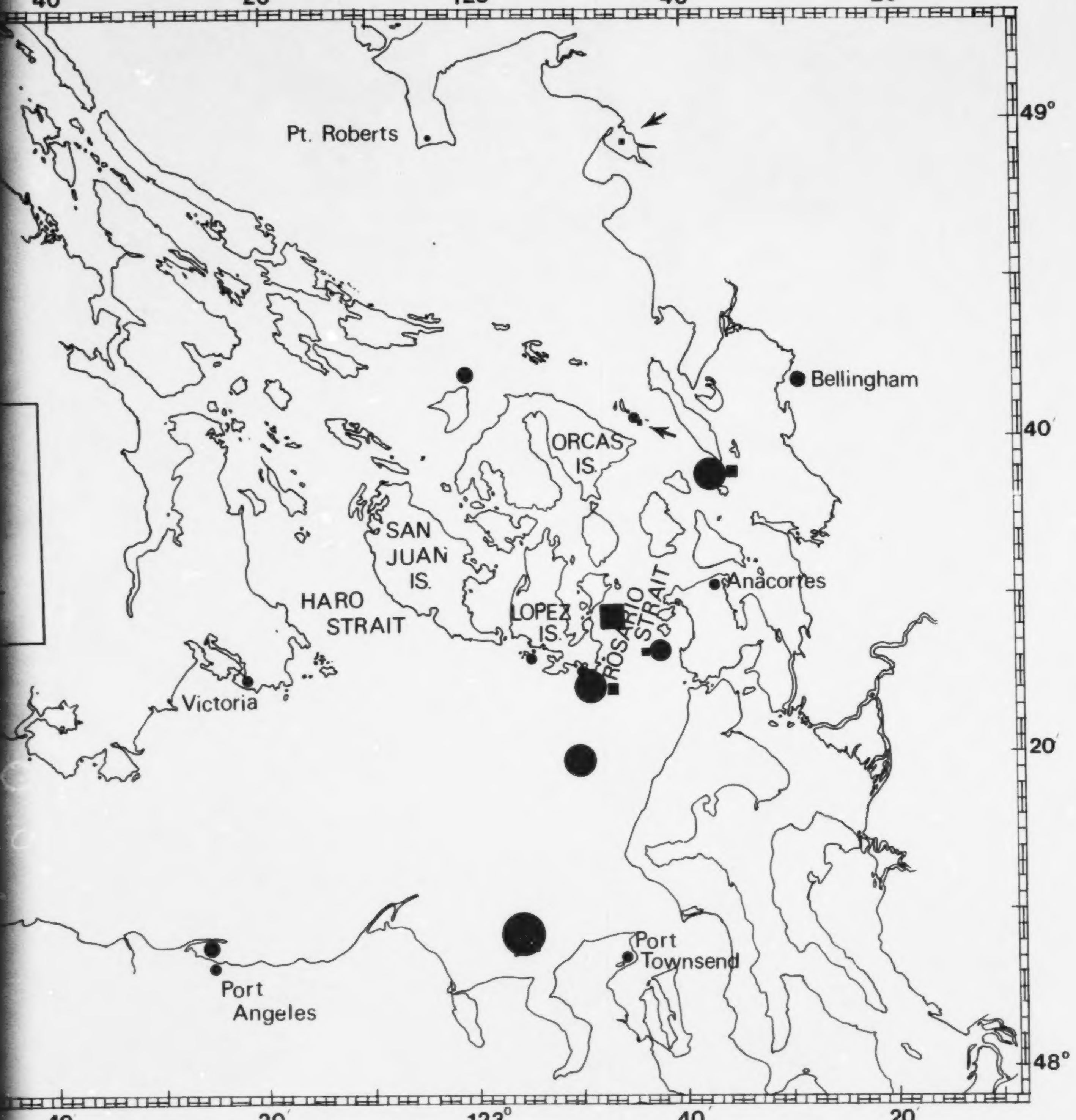
FIGURE 8. MAP SHOWING MAJOR COLONY-SITES FOR
CRESTED CORMORANTS.



NG MAJOR COLONY-SITES FOR PELAGIC AND DOUBLE-
ORMORANTS.

41 /4/2

B

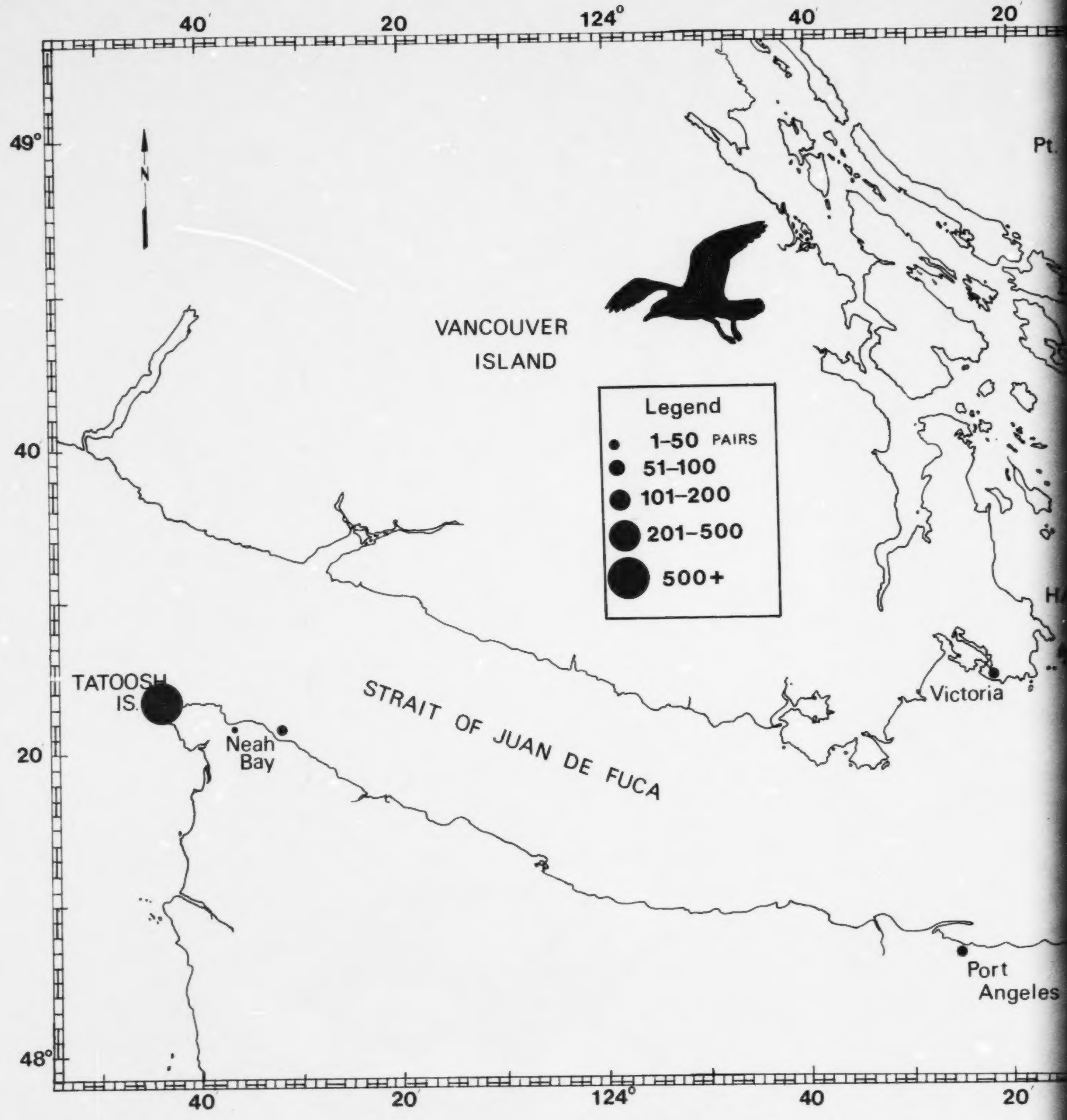


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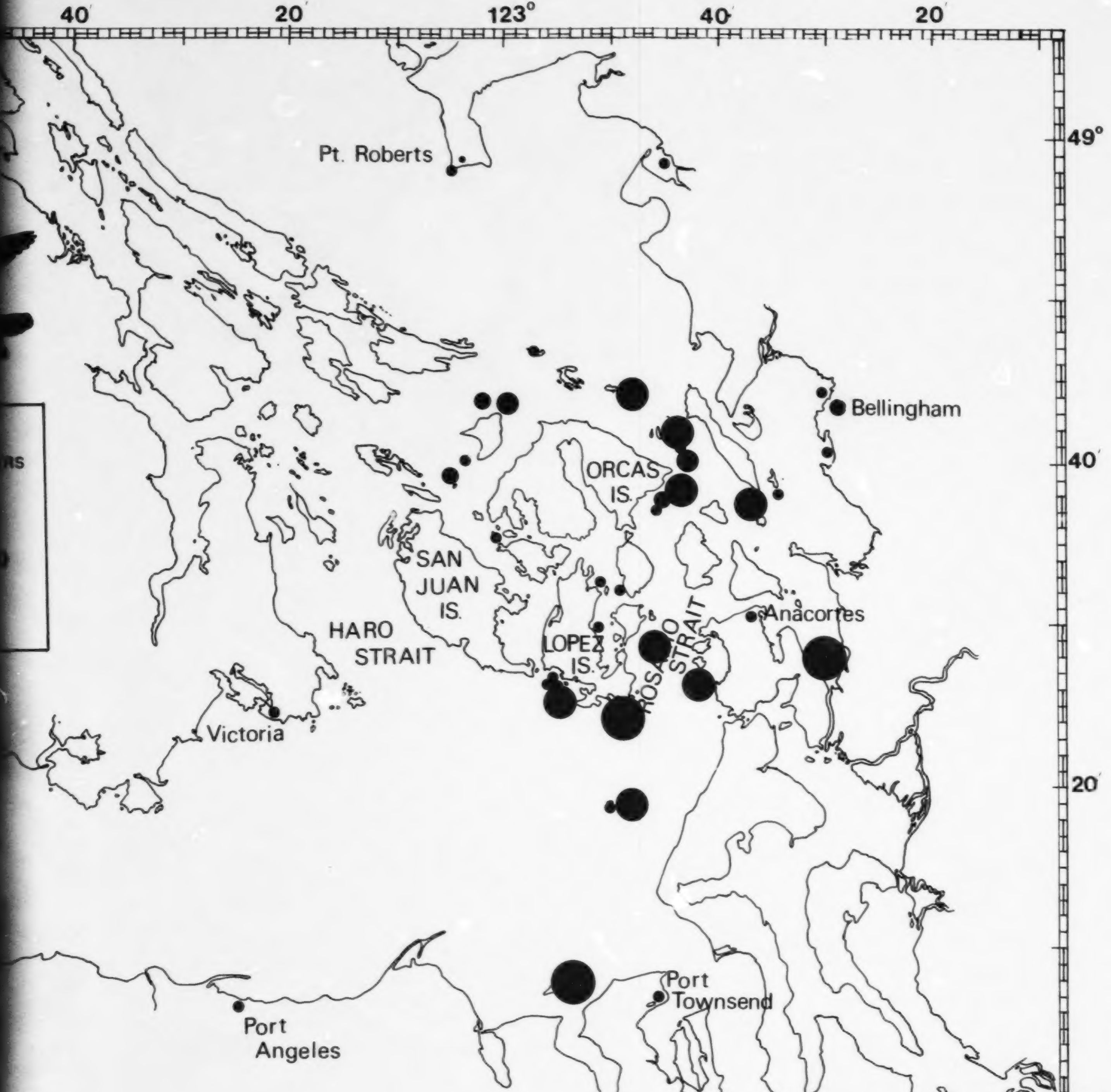
FIGURE 9. MAP OF MAJOR COLONY-SITES OF THE



MAJOR COLONY-SITES OF THE GLAUCOUS-WINGED GULL.

43/44

B

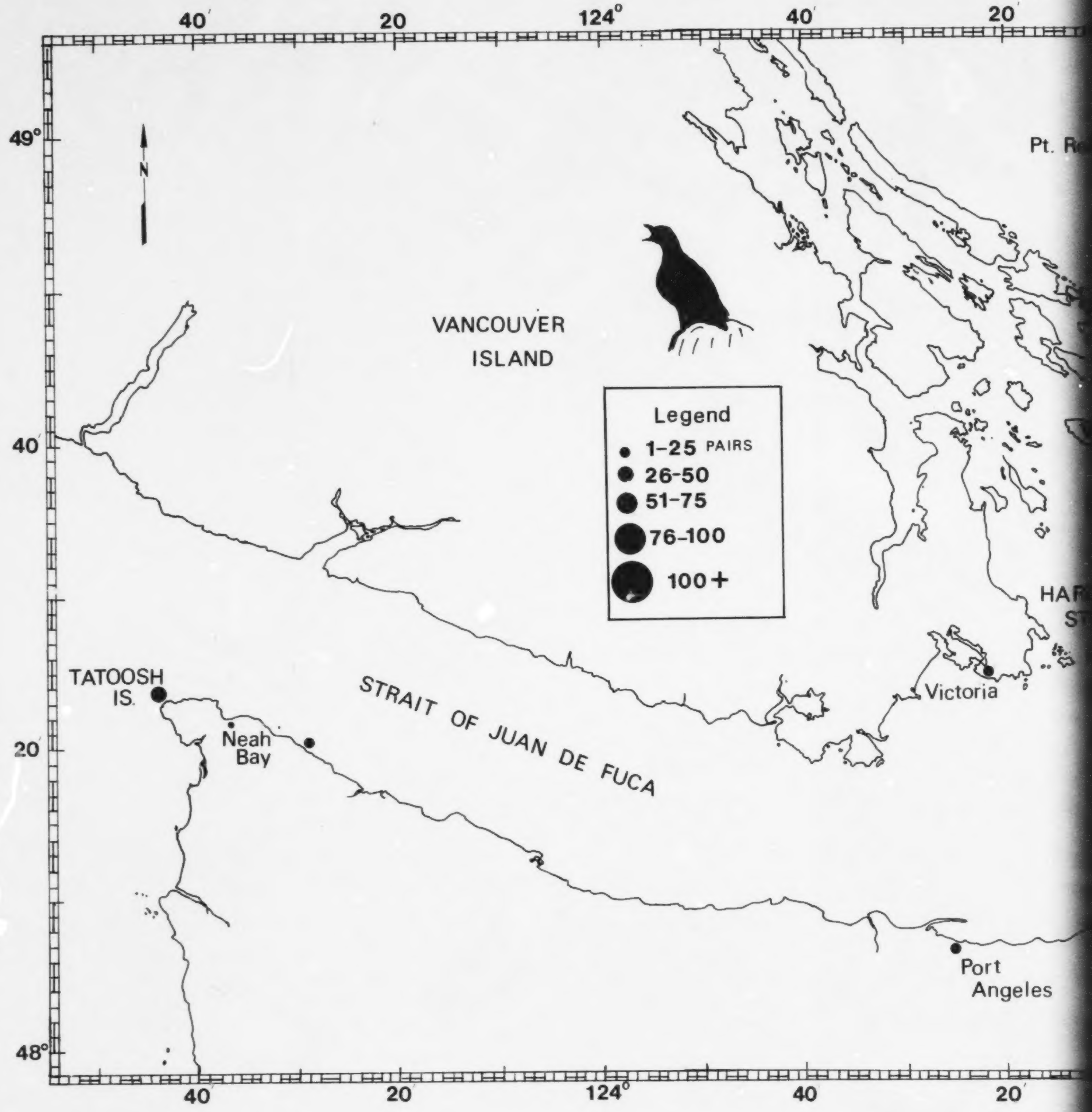


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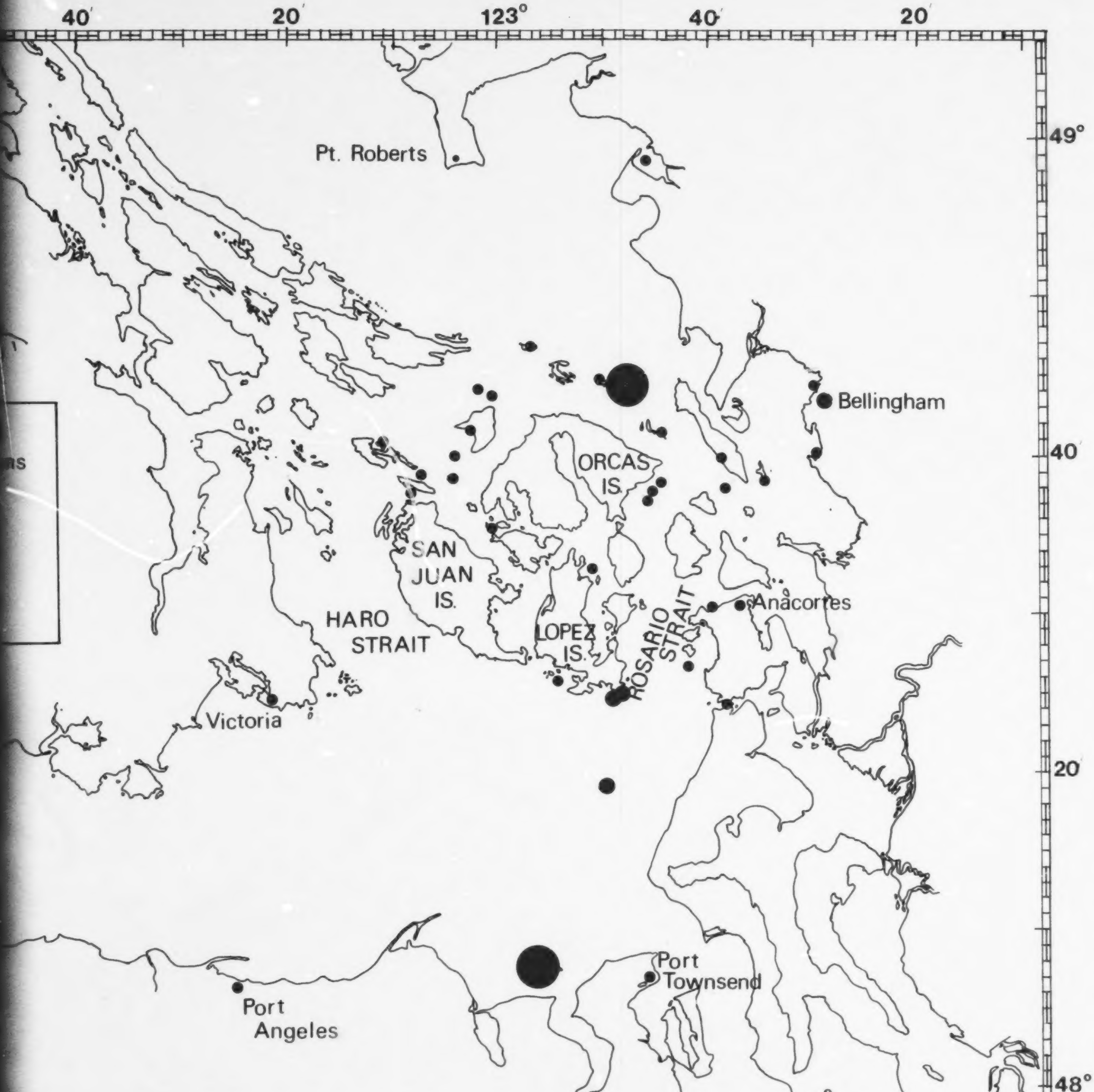
FIGURE 10. MAP OF MAJOR BREEDING SITES OF THE



MAJOR BREEDING SITES OF THE PIGEON GUILLEMOT.

45/46

B

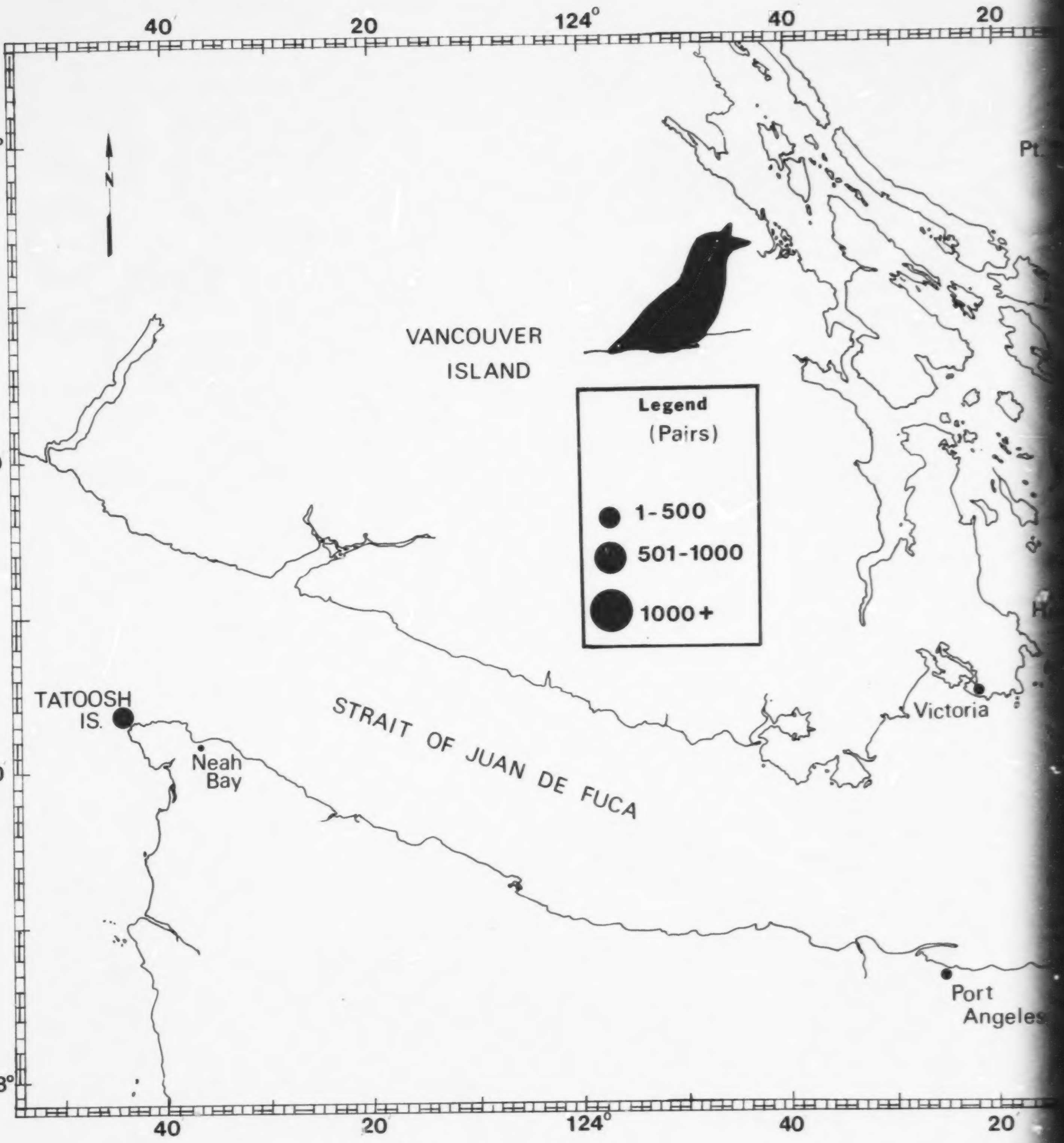


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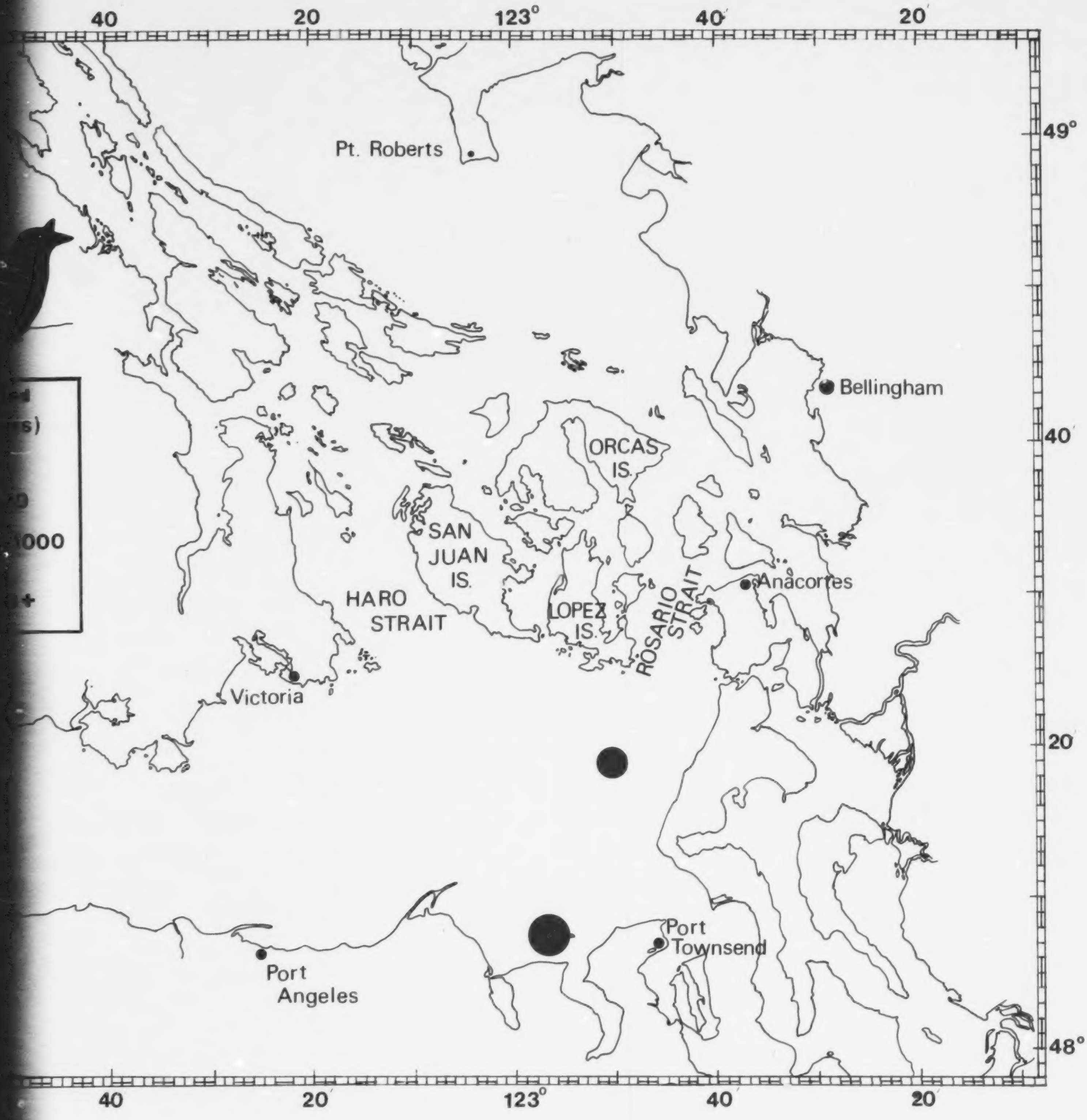
FIGURE 11. MAP OF BREEDING SITES OF THE



P OF BREEDING SITES OF THE RHINOCEROS AUKLET.

47/48

B

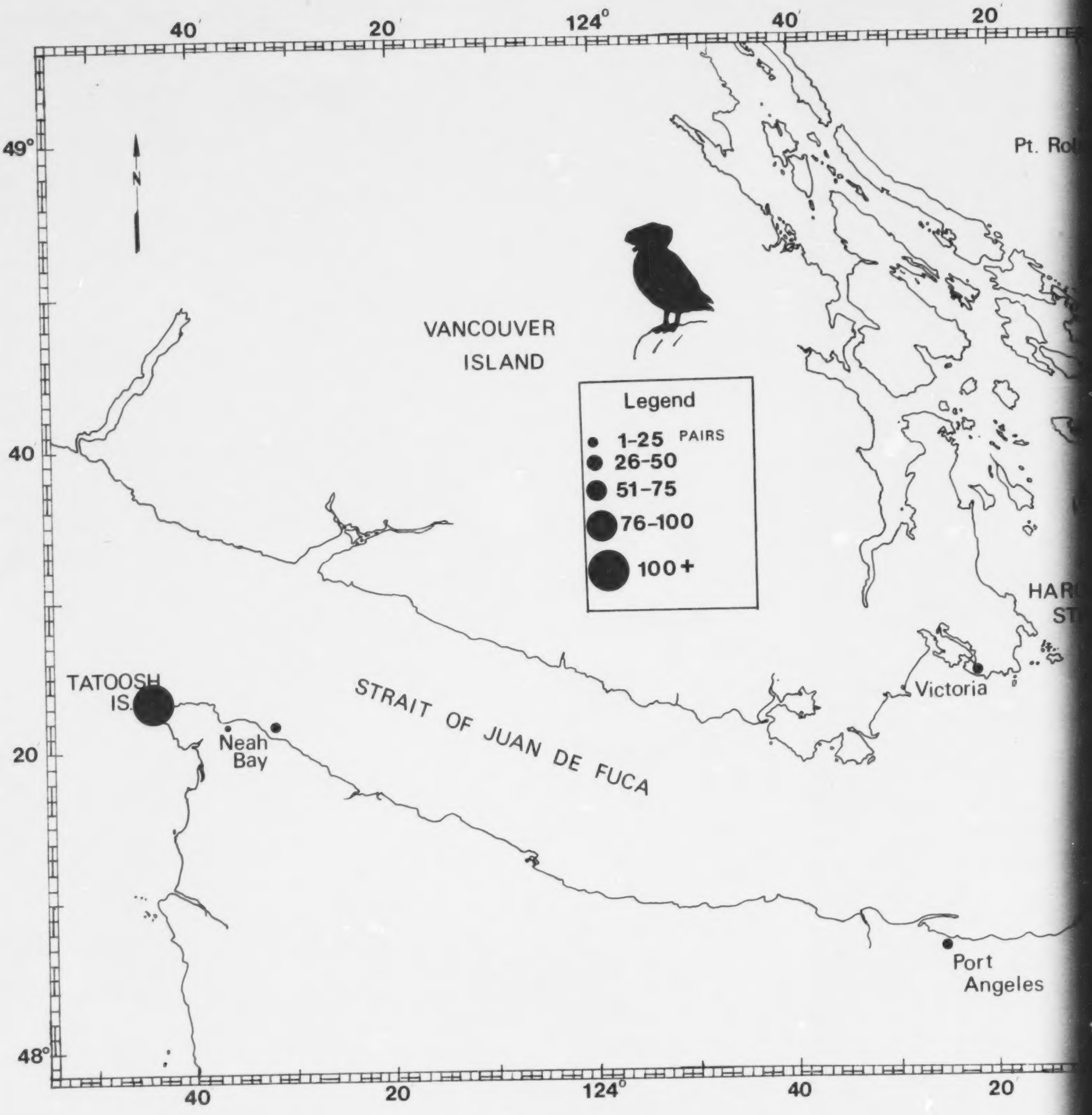


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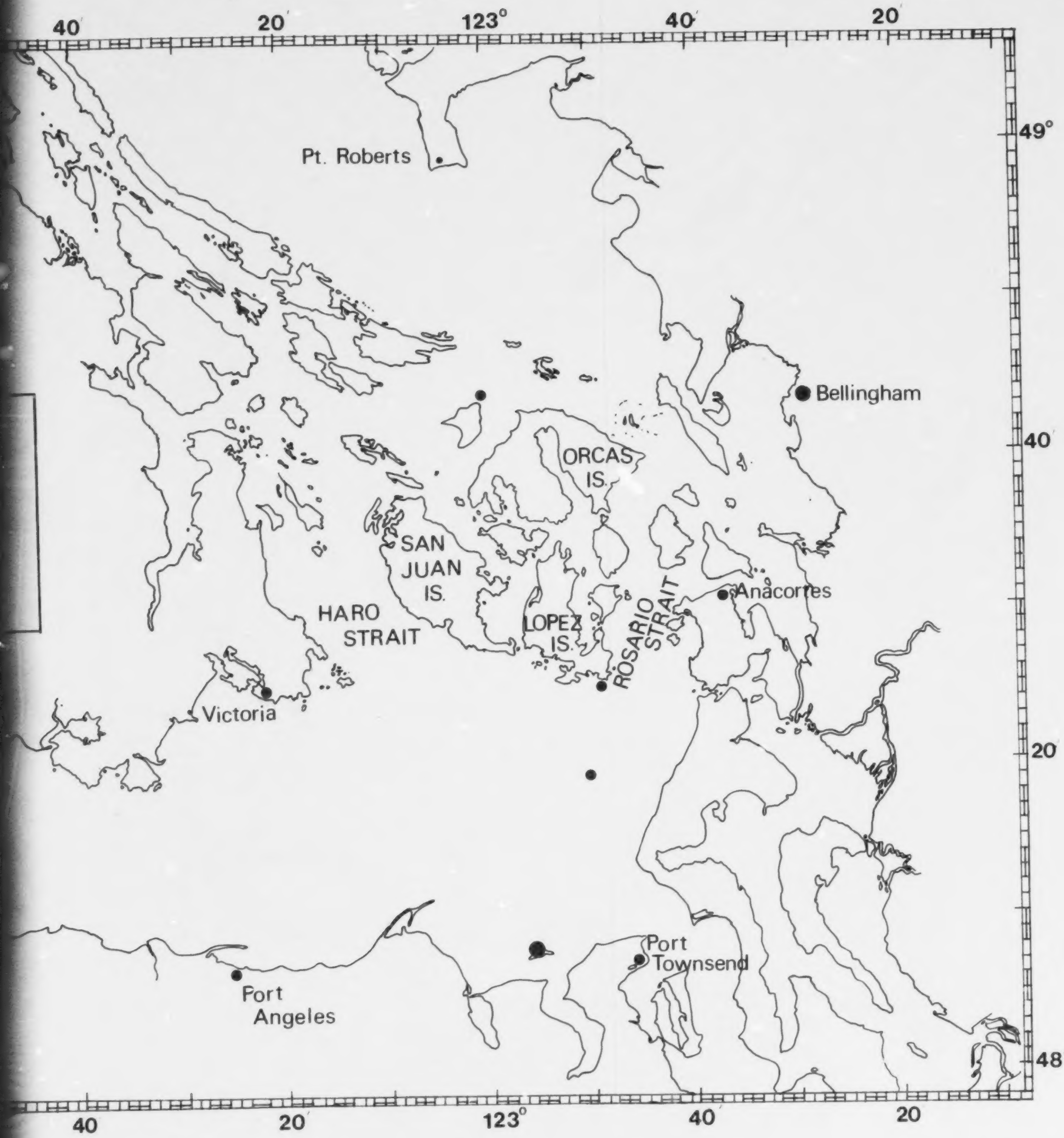
FIGURE 12. MAP OF BREEDING SITES OF THE T



P OF BREEDING SITES OF THE TUFTED PUFFIN.

49/50

15

Important species on Smith Island are the Rhinoceros Auklet (600 pairs), Pelagic Cormorants (100 pairs), and a small number of Tufted Puffins (1 to 3 pairs). Minor Island has approximately 100 pairs of gulls (Table 2), and Harbor Seals also "pup" there.

The most important sites on the south shore of Lopez Island are Colville Island (1,162 pairs) and Hall Island (269 pairs). The majority of birds are Glaucous-winged Gulls, although Colville Island has 80 pairs of Pelagic and 50 pairs of Double-crested Cormorants. At least 1 pair of Tufted Puffins nest on Colville Island (Table 2). Port Angeles contains a medium-sized colony of 40 pairs of Pelagic Cormorants nesting on pilings in the harbor (Table 2, Figure 8).

III-C-3. Admiralty Inlet (Region 4)

There are no breeding colonies in this region; however, there are scattered pairs of Pigeon Guillemots and Marbled Murrelets that apparently breed along the shoreline (Table 2).

III-C-4. Anacortes to Hale Passage (Region 5)

Important sites are Viti Rocks where a large colony of Pelagic Cormorants (80 pairs), Double-crested Cormorant (30 pairs), and Glaucous-winged Gulls occur, and unnamed islands at the southern end of Padilla Bay where there are over 500 pairs of Glaucous-winged Gulls (Table 2). Other breeding species are not numerous in this region.

III-C-5. Eastern Georgia Strait (Region 6)

Approximately 1,100 pairs nest in this region, of which 380 are Glaucous-winged Gulls at Drayton Harbor, Patos Island, and Puffin Island (Table 2). The paucity of birds is apparently due to the small number of islands in the region.

III-C-6. Western Georgia Strait (Region 7)

Since most of the suitable islands in this region are Canadian, we did not survey them. The only breeding birds we found nests of were 20 pairs of Glaucous-winged Gulls at Point Roberts (Table 2).

III-C-7. Haro Strait (Region 8)

The only important American islands in this region are Bare Island, Skipjack Island, and Cactus Island (Table 2, Figure 7). The 50 pairs of Pelagic Cormorant and 2 pairs of Tufted Puffin on Bare Island are particularly noteworthy.

III-C-8. Rosario Strait (Region 9)

There are nearly 1,900 pairs of birds on nine islands in Rosario Strait (Table 2, Figure 7). Glaucous-winged Gulls make up 83% of this total. Important colonies of cormorants are located on Bird Rocks, Williamson Rocks, and the Sisters Islands.

III-C-9. San Juan Islands--Northern Waters (Region 10)

At the present time there are only four islands which have important numbers of breeding marine birds (Table 2, Figure 6). While we recorded only 2 pairs of Pigeon Guillemots on Waldron Island, there are probably several pairs there (see Table 2, Region-Subregion 10-1), as projected from various censuses.

III-C-10. San Juan Islands--Interior Channels and Passages (Region 11)

The only colony sites in this region are on Low Island and Willow Island, both of which have very small numbers of gulls and guillemots (Table 2, Figure 7).

III-C-11. San Juan Islands--Interior Bays (Region 12)

There are many small islands in this region, but seabirds were found breeding only on Flower Island and Small Island (Table 2, Figure 7). A third site, Goose Island, was devoid of breeding birds in 1978 but formally had 60 pairs of Glaucous-winged Gulls (Manuwal and Campbell *in press*). The close proximity of many islands in this region to the larger islands (i.e., Orcas, Lopez) allows easy access by humans and mammals.

III-C-12. Canadian Waters (Region 13)

We did not survey islands in this region for breeding birds. Nevertheless, major colonies are present on some islands; most notable is Mandarte Island where there are large numbers of cormorants, gulls, and puffins (Drent and Guiget 1961 and Vermeer 1963). We do, however, project numbers of breeding Pigeon Guillemots and Marbled Murrelets (Table 2).

III-D. Breeding Bird Species Accounts

Accounts of the 29,600 pairs of 12 species (Table 2) in the study area are presented with pertinent facts of their occurrence.

III-D-1. Fork-tailed Storm Petrel

This species is found breeding in the study area only on Tatoosh Island (Table 2). This species normally feeds offshore and is found only rarely in the Strait of Juan de Fuca area. The species is a common breeding bird in suitable habitat from northern California to Alaska (Palmer 1962).

III-D-2. Leach's Storm Petrel

This species is also found breeding only on Tatoosh Island (Table 2) and is even more pelagic than the Fork-tailed Storm Petrel. This species is a common breeding bird from Mexico to Alaska (Palmer 1962).

III-D-3. Pelagic Cormorant

The distribution of breeding colonies in Washington is strongly influenced by the availability of steep, inaccessible cliffs. A few birds have adapted to nesting on man-made objects such as the pilings found at Port Angeles harbor (Table 2, Figures 7 and 8). These cormorants as well as other species are vulnerable to various types of human disturbance. If gulls are present nearby, their predation on cormorant eggs and young may be severe (Kury and Gochfield 1975). This type of vulnerability appears to have been responsible for reductions in Pelagic and Double-crested Cormorant numbers in the study area over the past 50 years. Casual analysis of early records in Dawson and Bowles (1909), Kitchin (1934), and Jewett et al. (1953) seem to indicate a reduction in numbers and shrinkage of distribution in the interior Strait of Juan de Fuca. For these reasons, this species may be especially affected by an oil catastrophe. Our estimate for the total population of Pelagic Cormorants in the study area is 950 pairs (Table 2).

III-D-4. Double-crested Cormorant

This species prefers to nest on less precipitous cliffs than the Pelagic. It is found breeding at five locations in the study area (Table 2, Figures 7 and 8). The total population in the study area is about 111 pairs, with another 400 on the outer coast (Manuwal and Campbell *in press*).

The most important colony sites in the study area are Colville Island (50 pairs), Viti Rocks (30 pairs), and Bird Rocks (90 pairs) (Table 2, Figures 7 and 8). All these islands are subjected to frequent disturbance by boaters and are along the major oil tanker shipping lane to the Cherry Point and Anacortes oil refineries.

III-D-5. Black Oystercatchers

This species has an extensive distribution but nowhere does it nest in high densities except on Destruction Island (outer Washington coast; Nysewander 1977) and Cleland Island (outer B.C. coast; Hartwick 1974). In the study area we estimate the total breeding population to be at least 41 pairs (Table 2).

III-D-6. Glaucous-winged Gull

Glaucous-winged Gull is the only gull nesting in the study area. It comprises approximately 25% of all breeding birds (Table 2, Figure 9). This species is found on nearly every predator-free island in the study area. This gull, as well as several other gulls, has shown an increase in numbers over the past several decades. This is due to increased protection and food availability. A consequence of this is increased predation pressure on other surface-nesting species, particularly the cormorants (see Manuwal (1978) for a review of this subject). Wherever gulls and cormorants are present in a single colony site (i.e., Colville, Bird Rocks, Williamson Rocks, and Protection Island), the effects of human disturbance may be magnified. Consequently, the cormorant colonies at the above mentioned sites must be closely monitored. Despite illegal human intrusions onto Fish and Wildlife Service Refuge Islands, most gull colonies have increased since protection (Thoresen and Galusha 1971). This species numbers and distribution are summarized in Table 2, Figures 7 and 9.

III-D-7. Common Murre

This species is found breeding in the study area only on Tatoosh Island (Table 2). It is a common breeding species from southern California to Alaska (Tuck 1960).

III-D-8. Pigeon Guillemot

Pigeon Guillemot and Marbled Murrelets nest in locations difficult to census. These species therefore require additional censusing and analysis. Our estimates for Pigeon Guillemots are underestimates, since we could not spend time finding nest sites. The data are therefore presented as estimates for each island where we had strong evidence of breeding (Figures 7 and 10), and as projected totals (Table 2). Our estimate for total breeding population is 1,900 pairs.

III-D-9. Marbled Murrelet

Marbled Murrelets are known to nest in trees in the Pacific Northwest region (Binford et al. 1975). Our estimates for this species are presented as projected total populations for each region (Table 2). Caution is necessary when interpreting both Pigeon Guillemot and Marbled Murrelet projected totals as both species may fly considerable distances to feed. Our projected totals merely reflect birds observed; thus, there is no way of determining the exact location of the breeding sites. The data therefore may more accurately reflect feeding areas rather than breeding site locations. Our estimate for the total breeding murrelet population is 550 pairs (Table 2).

III-D-10. Cassin's Auklet

Cassin's Auklet is found only on Tatoosh Island where an unknown but probably small number breed (Table 2). This species is found only along the coast from Mexico to Alaska (Udvardy 1963).

III-D-11. Rhinoceros Auklet

Rhinoceros Auklets are found from the Farallon Islands, California, to the northern Gulf of Alaska (Udvardy 1963). This species requires deep soil for nesting, so it is somewhat limited by nest site availability. The nearly 18,000 pairs of auklets in the large colonies on Protection Island, Smith Island, and a small one on Tatoosh Island comprise approximately 60% of all breeding birds in the study area (Table 2, Figure 11). Its high vulnerability to oil contamination makes this species especially important.

Knowledge of the breeding biology of this species is now well documented (Leschner 1976, Manuwal et al. unpubl., Wilson 1977). It feeds primarily on herring, smelt, and sandlance. Information from sea watches and boat surveys indicates that birds from Protection Island may fly several miles in all directions to feed. In August 1977, Ulrich Wilson (pers. comm.) found a large group of apparently flightless Rhinoceros Auklets at Point Wilson. Later, he collected a molting flightless bird in southern Puget Sound, thus documenting that potentially large numbers of post-breeding (and molting) Rhinoceros Auklets are present in the study area. This is very significant since these birds are extremely vulnerable to oil during this time of their life cycle. More information is needed on feeding and molting areas for this species.

III-D-12. Tufted Puffin

Perhaps no other species has shown such a population decline in the study area as the Tufted Puffin. Relatively large populations once occurred on Bare Island, Waldron Head, Flattop Island, Smith Island, and Protection Island. Smaller numbers were widely scattered through the San Juan Islands (Jewett et al. 1953). In 1978, we found only 78 pairs east of Tatoosh Island. Reasons for this decline are not clear, although a decline in the herring fishery and increased human disturbance in the San Juan Islands have undoubtedly contributed to this decline. The only substantial colonies exist on Protection Island and Tatoosh Island (Table 2, Figure 12) and the total population in the study area is estimated as 228 pairs (Table 2).

III-E. Bird Movements

Sea watches were valuable in determining some daily bird movements within parts of the study area (see Figure 2), though these movements are not fully known. These movements, which may take birds from one of our study regions to another, are essentially of two types.

First, birds appear to take regular routes from roosts to foraging areas, then often make further movements during the day to take advantage of specific, varying foraging opportunities. This is a very important factor in understanding locations of seabird concentrations within the study area. These movements generally take place from dawn for about two hours and from two hours prior to dusk until dark. These movements vary seasonally. In summer, nesting species move to and from colonies to feeding areas and (in the case of Rhinoceros Auklets) may gather in "staging" areas near colonies prior to entering nest burrows after dark. There may be additional feeding flights and foraging activity during hours of darkness by some species.

In nonbreeding seasons there are fewer bird flights from colonies like Protection Island and Smith Island, but in areas along the southern shore of Lopez Island the summer traffic is replaced by at least as heavy flights of cormorants from roost sites which are the same or near summer colony sites. The extensive daily summer movements of Rhinoceros Auklets away from Protection Island, west along the Olympic Peninsula shoreline, east to Admiralty Inlet, and north into San Juan Channel and Rosario Strait may be essentially duplicated in winter by Common Murres moving from night-time "roosts" in the Strait of Juan de Fuca to the same feeding areas.

A second type of movement is superimposed on the first. This consists of local feeding activity, with birds flying perhaps a very short distance, feeding while floating down-current and then flying up-current again. This is a common type of feeding behavior and is often apparently directly related to tidal conditions. These short flights can obscure data on other movements so sea watch data require careful analysis.

Migration was noted only once or twice. Migration is less obvious in the geographically complex study area than along open ocean coasts, and detection of migration would require seasonal, daily dawn-to-dark observations which were beyond the scope of this study.

Sea watch observations were helpful in interpreting density data. A sea watch census location can have very low numbers of birds present at any given time, but during peak hours or during an entire day the site can be passed by very large numbers of seabirds.

III-F. Regional Distribution, Abundance, and Species Composition of Marine Birds

Specific data that document this section are in the tables in Appendices IV and V. In regional accounts below, we have presented data to illustrate selected occurrences, seasonal variations, variations between subregions and particular species situations which stand out as especially pertinent to the objectives of the study and of biological significance.

III-F-1. Region 1. Swiftsure Bank

This region consists entirely of open water and is situated just offshore of Cape Flattery at the entrance to the Strait of Juan de Fuca (Figure 1). As such, this region is the most "pelagic" of our study areas, reflecting the influence of the avifauna of the outer coast of Washington and deeper offshore waters. Black-footed Albatross, fulmars, shearwaters, storm petrels, jaegers, gulls, and alcids appear here.

The widely held opinion that oil spilled in open water causes no damage is faulty. In this region, a large oil spill during the Summer that coincided with the annual migration of the Sooty Shearwater could result in the loss of tens of thousands of birds. Flocks numbering 1,000,000 birds have been observed just south of this region, and they undoubtedly pass through this region.

Data were not obtained during the Winter period of unsettled weather and sea conditions. However, some shipboard data indicate densities of birds similar to those in the Strait of Juan de Fuca--Outer region near Cape Flattery. In the late Summer, Common Murres moving into the Strait of Juan de Fuca pass through this area, and large numbers of Common Murres are present offshore during the Winter months.

III-F-2. Region 2. Strait of Juan de Fuca--Outer

Biologically, this region has two major components: the open water and the shoreline areas. The two are very different in their faunal composition, a reflection of the deep waters of the strait.

The open waters of the strait vary greatly seasonally in the density of birds. In the Spring, the density is only 16.6 birds/km^2, and that projects to nearly 31,000 birds in this subregion, but 21,000 of these are Bonaparte's Gulls, an abundant Spring migrant. This period is also marked by low diversity. Only during the Summer period does this subregion have a lower density: 4.3 birds/km^2 of five species. Only the Common Murre appears in relatively large numbers, a mere 6,500 birds. The Fall period, as in many areas, is the period of highest densities, 89.2 birds/km^2, and greatest projected numbers, 170,000 birds. Of these the Common Murre accounts for 140,000 of the total number. The presence of this highly vulnerable species to oil pollution, gives the area its high Bird Oil Index value (Appendices IV and V) in the Fall and Winter. The Fall and Winter are also the periods of greatest avian diversity.

The Common Murre deserves special attention because of its large numbers in the subregion, vulnerability to oil pollution, and dramatic seasonal changes in density and projected numbers. Table 3 summarizes the density and projected totals for the 1978 data period. The open water subregion of Region 2 shows a tremendous change in numbers from no murres being seen in April to nearly 240,000 birds in September and then gradually tapering off (Figure 13). A similar year pattern is seen represented in the open water subregion of Region 3.

Table 3. Monthly Changes in Density and Projected Totals of the Common Murre in the Open Water Areas of Regions 2 and 3

	Region 2, Open Water[1]		Region 3, Open Water[1]	
	Density (birds/km^2)	Projected total	Density (birds/km^2)	Projected total
January	---[2]	---	---	---
February	---	---	---	---
March	0.32	30	0.95	1,600
April	0.00	0	0.25	400
May	0.65	1,200	0.98	1,600
June	---	---	0.28	450
July	3.45	6,500	0.39	640
August	31.31	59,000	22.71	37,000
September	126.64	240,000	10.17	17,000
October	59.10	111,000	17.47	28,000
November	33.36	63,000	11.00	18,000
December	34.61	65,000	24.24	40,000

[1] Subregion 1 in both cases.

[2] No data are available. Aircraft censusing not yet begun.

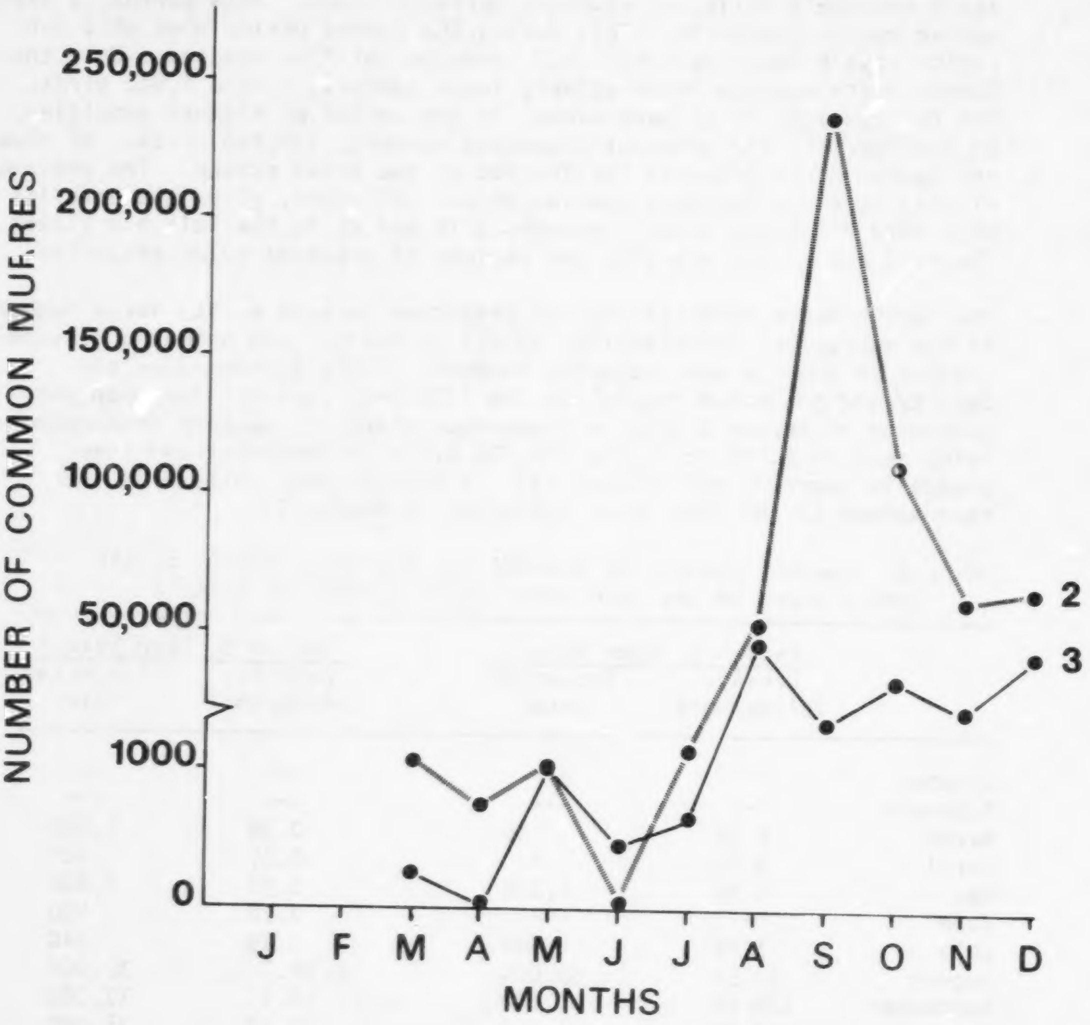


Figure 13. Projected total numbers of Common Murres in the open water subregion of regions 2 and 3.

The origin of these birds is of interest. These two regions in September account for perhaps 85% of the entire Common Murre breeding population in California, Oregon, and Washington, most recently thought to number near 300,000 breeding birds. Little is actually known of the origin of these birds, but in mid-July of 1978 Common Murres were observed constantly flying northward along the coast of Washington (Speich pers. obs.). Furthermore, Tuck (1960) reports the occurrence of birds banded in Oregon recovered in Washington. But undoubtedly, Common Murres from more northern breeding colonies also winter in the area. Thus it appears that during the Fall and Winter these two regions may contain a significant portion of the California, Oregon, and Washington Common Murre breeding population.

The shoreline subregions of this region are somewhat different from those of some other regions. Nowhere are there large numbers of dabbling ducks as in other regions, as this region is lacking large, shallow protected bays. The only shoreline area with good numbers of birds is the Cape Flattery subregion, and there the Glaucous-winged Gull accounts for 70 to 90% of all birds. Even without the numbers of gulls the area is very important due to the existence of the seabird nesting colonies on Tatoosh Island (see Breeding Birds section).

III-F-3. Region 3. Strait of Juan de Fuca--Inner

As in Region 2, the open water subregions of this region contain large numbers of Common Murres, especially in the Fall and Winter periods (Appendices IV and V). Furthermore, the region as a whole is extremely diverse (Appendix III), with waterfowl and shorebirds comprising a large proportion of the projected totals. The Jamestown subregion is by far the most important throughout the year. Figure 14 compares this subregion to those extending to Port Angeles. Large numbers of ducks, geese, gulls, and shorebirds contribute most significantly to the total numbers. This may relate to apparent high productivity of the shallow water areas and from shelter from prevailing winds.

As in Region 2, the open water subregion contains large numbers of Common Murres, especially in the Fall and Winter periods (Table 3, Figure 13, and Appendix IV). However, the region as a whole has a higher species diversity (Appendix III), with waterfowl and shorebirds making a large contribution.

Scoters are found in large numbers in Discovery Bay, especially in the Fall through Spring. In Spring they are often associated with the spawn of Herring. Although these areas do not reach the high numbers of some regions, they nonetheless are impressive for their diversity of waterfowl. At times, large concentrations of American Wigeon are present in Sequim Bay and the Jamestown subregion, especially in the Fall.

The southern end of Lopez Island is an area that contains important nesting colonies. But the Fall through Spring months reveal that the area is important for cormorant roosting. These predacious diving birds must spend the night and part of the day out of the water. Even small low barren rocks are important as roosting areas. The cormorants are

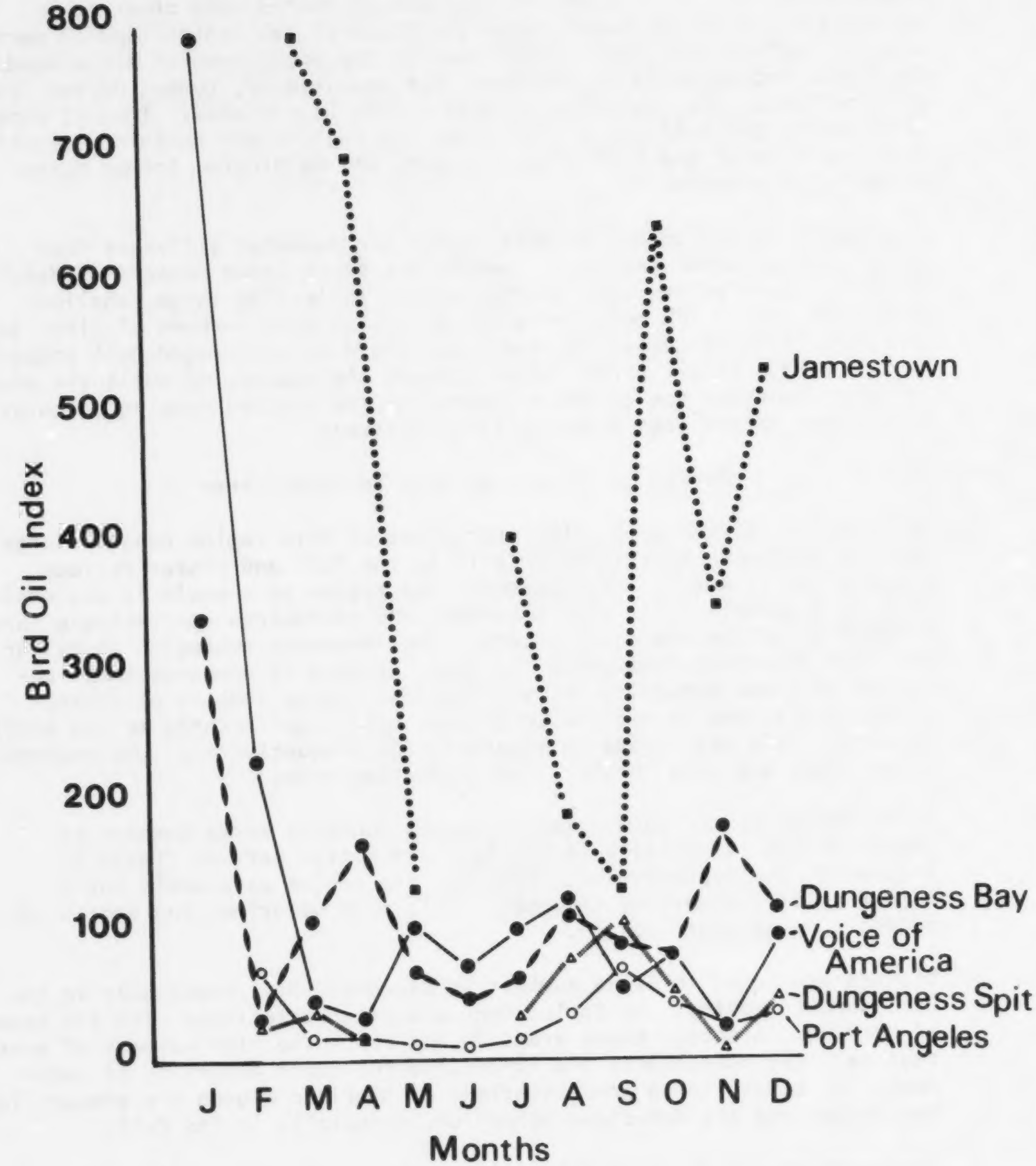


Figure 14. Bird-Oil Index values for subregions between Port Angeles and Jamestown, Olympic Peninsula, 1978.

all susceptible to wetting as well as oil pollution. Unlike other water birds, they must periodically dry and re-constitute their protective feather jackets otherwise they will succumb to hypothermia. Many of these roosting birds apparently commute daily around and over Shannon Point/Anacortes to spend the day feeding in Samish, Fidalgo, and Padilla bays.

The Victoria, Vancouver Island, subregion (18) was surveyed at opportunity. Our data are minimal (Appendix IV) since only three winter airplane surveys are available, but they are generally consistent with the findings of Campbell et al. (MS) from 12 surveys carried out by boat from 21 September, 1975, through 31 March, 1976. The area's importance is second only to two others in the Winter for all the Strait of Juan de Fuca and similar to only three others (Appendix V). In September and October especially, and later in the Winter, various rocks are important as roosting sites for up to 3,000 Brandt's Cormorants. As many as 2,000 of this species may use Race Rocks and form part of the local movement patterns (Campbell et al. MS).

Sea watches in Summer at Ediz Hook (Figure 2) revealed the regular westward movement of Rhinoceros Auklets and gulls in the morning, apparently from the Protection Island colonies, to foraging areas and returning east in the afternoon. Local feeding movements were also evident.

III-F-4. Region 4. Admiralty Inlet

This small region in itself is not as important to birds as some of the other areas such as bays, etc. However, its rating (Appendix VI) does not reflect that this narrow passage is the focal point of bird movements into and out of Puget Sound from the Strait of Juan de Fuca. Our sea watch data reveal the constant movement of birds through the passage and the importance of the area as a feeding site. These data further suggest that a significant number of Rhinoceros Auklets move daily through the passage into Puget Sound. These birds are in the most part from the Protection Island colony.

During the Spring the area is particularly utilized by grebes and Bonaparte's Gulls. Rhinoceros Auklets are found in the area during this period, and they predominate in the Summer. During the Fall and Winter, Common Murres are nearly always present. The Glaucous-winged Gull is present at all times of the year.

Heavy net movements during the nesting season, revealed by sea watches from Point Wilson, were comprised of Rhinoceros Auklets and Glaucous-winged Gulls moving from the direction of colonies on Protection Island to foraging areas to the east in Admiralty Inlet. In Winter, large numbers of Common Murres were seen going east in the morning toward Admiralty Inlet. This species spends the night on the water, apparently in open waters of the Strait of Juan de Fuca. Gulls also moved eastward in the morning, but westward in the afternoon in Winter.

III-F-5. Region 5. Anacortes to Hale Passage

Shallow Bellingham, Samish and Padilla bays account for large numbers of birds at all seasons. Samish and Padilla bays accounted for about 80% of the region's total projected bird numbers in the Spring (Appendix V). Ducks, and especially brant, are very abundant there. These two bays are extremely important for the Pacific Flyway population of Black Brant moving north in the Spring.

The projected total number of 22,000 Western Grebes in Bellingham Bay represents one of the largest recorded wintering populations on the Pacific Coast (and corresponds closely with minimum estimates from past years). The study area's only wintering flock of Whistling Swans--about 50 birds--occurs at the Nooksack delta in Bellingham Bay.

Deeper open waters within the region are important for loons, grebes, and Common Murres. Very large numbers of gulls migrate through the region in the Spring and Fall.

Bald Eagles are present in the river deltas, estuaries, and shorelines during the year. Peregrine Falcons winter regularly in the Samish and Padilla bay areas.

Shorebird numbers are understated in our figures due to the inaccessibility of habitat during censusing, and projected totals and Bird Oil Indices in these shallow estuaries reflect this. Large numbers of shorebirds use the sand/mud intertidal areas of Fidalgo, Samish, and Padilla bays, and the Nooksack delta. Dunlins are the predominant species from November through April, Western Sandpipers are the most numerous Fall and Spring migrants.

Herring spawn affects Spring numbers of diving ducks and gulls in the Hale Passage area, though 1978 figures do not indicate this.

Hunting affects distribution of birds and numbers censused in Bellingham, Samish, and Padilla bays. Nesting colonies (primarily Glaucous-winged Gulls) are at Viti Rocks and at the Swinomish Slough area at the south end of Padilla Bay.

Thousands of American Wigeon, Common Pintails, and Mallards are frequently observed in farm fields 15 km or farther from the bays after hunting pressure ceases. Large flocks of Glaucous-winged and Mew Gulls also forage in wet fields. Spring plowing may attract hundreds behind a single tractor, even when large areas of intertidal foraging habitats are exposed at low tides. The interrelationship of these habitats, species, seasons, and activities should be studied further.

In the Summer, Padilla Bay is particularly important for nonbreeding ducks. This is understated (Appendices IV and V) due to lack of aerial censuses during the period.

The Padilla Bay sea watch census location, at the tip of the gravel spit south of Point William, Samish Island, was in the midst of one of the highest densities of wintering waterfowl in the study area. However, populations in the area appeared static, composed largely of brant and ducks, and there was virtually no net movement recorded in three censuses. Birds appeared to remain in the area during all hours of daylight, except for dislocations caused by hunting. However, movements during hours of darkness are possible, as the Washington Department of Game (R. Jeffrey pers. comm.) states that brant do not spend the night on Padilla Bay.

III-F-6. Region 6. Georgia Strait--Eastern

Large numbers of brant use Lummi, Birch, and Boundary bays and Drayton Harbor during the Spring (Appendix IV). Large numbers of ducks are also present from Fall through Spring. Diving ducks winter along the outer shorelines of the region, and very large number of scoters were attracted in Spring during the herring spawn. Data from the first-year censuses suggest a very important movement of scoters, for example, into this region and Region 7 during the Herring spawn season of April-May (Table 4, Appendix IV). Nonbreeding diving ducks spend the Summer along the coast and in Boundary Bay.

Table 4. Regional Distribution and Numbers of Scoters in the Study Area, 1978

	Winter		Spring	
Region	Number	Percent	Number	Percent
2	2,400	1.5	1,500	3.8
3	1,900	5.8	5,600	29.5
4	70	>1.0	10	>1.0
5	13,100	11.6	11,000	20.1
6	20,000	52.2	50,000	31.4
7	3,500	24.2	23,000	5.3
8	320	>1.0	730	>1.0
9	350	3.0	2,900	>1.0
10	2,300	>1.0	60	3.5
11	1,000	>1.0	210	1.6
12	1,600	>1.0	510	3.6
Projected Total	65,000		96,000	

Loons, Common Murres, and other diving birds use the offshore waters in Winter. Birds feed in tide-rips (convergence lines) in very large numbers on occasion, though the distribution is patchy and variable.

Shorebirds (especially Dunlins) occur in large numbers (up to 50,000) in Spring, Fall, and Winter, particularly in Boundary Bay. These and other species are understated in our Boundary Bay PT and BOI ratings (Appendix IV) due to our study area boundary and lack of a close-inshore and shore census component. Numbers and BOI ratings are very likely 3 to 5 times higher than our figures (see Vermeer and Levings 1977).

Hunting pressure may concentrate ducks in Birch Bay and Drayton Harbor, though large numbers remain in Drayton Harbor after hunting season until birds migrate in the Spring.

III-F-7. Region 7. Georgia Strait--Western

Diving ducks and gulls use the region's shoreline areas, with Herring spawn attracting very large numbers (Table 5). Concentrations of Oldsquaws (600-700), Common Murres, and Arctic Loons also occur seasonally, and one observation of 5,400 Marbled Murrelets passing Point Roberts in Winter of 1978 represents perhaps the largest number of this species ever seen, and may indicate that the Point Roberts/Tsawwassen area is a major Winter roost for the species. Very large numbers also use the Roberts and Sturgeon Banks areas just outside the study area (see Vermeer and Levings 1977).

Tsawwassen Bay appears to be an important night-time roosting area for many species (this may be established further in 1979).

While Common Murres and loons are found in Winter in the open waters, seasonal densities are quite low (see Robertson 1974).

In order to more accurately estimate the entire marine bird population in the Georgia Strait--Western region, we adjust the estimate by using average shoreline density values for Summer habitat along Haro Strait. This increases numbers from about 5 to 20% for the area (Table 5).

III-F-8. Region 8. Haro Strait

As in Georgia Strait--Western region, PTs and BOI values are low due to lack of a shoreline component in Canadian Waters. This area also has extensive shallow foraging areas, roosts, and some breeding colonies. Based on data from the Canadian Waters subregion and a sample of a similar shoreline habitat in the San Juan Islands, and extending the area west to the Vancouver Island shore, adjusted Projected Totals and Bird Oil Index values are conservatively estimated as shown in Table 6. For Haro Strait as a whole, population numbers are higher by as much as 250% than our projection in Table 8. These adjusted figures are reasonable in that shallow shore areas are very limited on the U.S. side of Haro Strait, and rocks and breeding colonies are virtually nonexistent there.

Table 5. Adjusted Estimates of Marine Bird Numbers and Indices for Shoreline and Open Water Components of Region 7, Western Georgia Strait

	Spring	Summer	Fall	Winter
Shoreline[2]				
D[1]	1,432	122	423	677
PT	55,000	4,700	17,000	26,000
BOI	1,093	157	274	427
BOI/km^2	28.46	4.09	7.13	11.11
Open Water[3]				
D	8	2	3	6
PT	2,900	600	1,100	2,100
BOI	63	12	16	44
BOI/km^2	0.17	0.03	0.04	0.12
Total				
D	144	13	45	69
PT	58,000	5,300	18,000	28,000
BOI	1,156	169	290	471
BOI/km^2	2.87	0.42	0.72	1.17

[1] D = density, birds/km^2; PT = projected total; BOI = Bird Oil Index; and BOI/km^2, Bird Oil Index/km^2.
[2] Adjusted.
[3] Data from Appendix IV, Table 8.

III-F-9. Region 9. Rosario Strait

Large numbers of gulls, alcids, and cormorants feed in Rosario Strait, with Rhinoceros Auklets especially using the southern part during their nesting season whereas Common Murres are abundant during the Winter.

Cormorants roost on the rocks within the Strait and perform feeding flights at first light and return before dark. Numbers censused during daylight hours consequently represent only a part of the numbers present during darkness. These numbers are largest during the Fall season (Appendix IV). Several important nesting colonies are within Rosario Strait (Table 2).

At the Green Point sea watch census location, large net movements of cormorants and Common Murres took place daily in Rosario Strait during the Winter. Cormorants moved north after dawn from the direction of roosting rocks in mid-strait and along the southern shore of Lopez Island. These flights split near Green Point, with flocks going up

Table 6. Region 8. *Haro Strait Adjusted Estimates for the Shoreline and Open Water Components of the Two Subregions*

			Spring	Summer	Fall	Winter
0801 Northern Haro Strait	S	D=[1]	163	158	474	306
		PT=	3,200	3,100	9,300	6,000
		BOI=	56	66	89	124
		BOI/km^2=	2.86	3.37	4.54	6.33
	W	D=	3	7	10	24
		PT=	1,100	2,300	3,400	8,000
		BOI=	23	53	45	160
		BOI/km^2=	0.07	0.16	0.14	0.49
Total		D=	12	15	37	40
		PT=	4,300	5,300	13,000	14,000
		BOI=	79	119	134	284
		BOI/km^2=	0.23	0.34	0.38	0.81
0802 Southern Haro Strait	S	D=	100	54	50	114
		PT=	7,000[2]	3,800	3,500	8,000
		BOI=	200	78	58	145
		BOI/km^2=	2.9	1.11	0.83	2.07
	W	D=	8	2	6	21
		PT=	2,400	600	1,800	6,200
		BOI=	41	13	37	130
		BOI/km^2=	0.14	0.04	0.13	0.45
Total		D=	21	12	15	42
		PT=	7,400	4,400	5,300	15,000
		BOI=	75	91	95	275
		BOI/km^2=	0.21	0.25	0.26	0.77

Table 6. (Continued)

			Spring	Summer	Fall	Winter
Summary	S	D=	112	77	145	156
		PT=	10,000	6,900	13,000	14,000
		BOI=	256	144	147	269
		BOI/km^2=	2.86	1.61	1.64	3.00
	W	D=	6	11	8	23
		PT=	3,500	6,900	5,200	14,000
		BOI=	64	66	82	390
		BOI/km^2=	0.10	0.11	0.13	0.63
Total		D=	20	20	25	40
		PT=	14,000	14,000	18,000	28,000
		BOI=	320	210	229	659
		BOI/km^2=	0.45	0.30	0.32	0.93

[1] D = density; PT = projected total; BOI = Bird Oil Index; and BOI/km^2 Bird Oil Index/km^2.

[2] Density estimated from data obtained from San Juan Airplane Shoreline 009 segment.

Rosario Strait, Bellingham and Guemes channels, and even Thatcher Pass. Some birds spent the day foraging and roosting in Fidalgo, Padilla and Samish bays. Additional large flocks of cormorants bypassed Green Point, flying directly over Fidalgo Island and Anacortes. Cormorants were also observed flying west through Deception Pass at dusk, heading for roost rocks in Rosario Strait after apparently spending the day in waters east of Whidbey Island.

Common Murres also move north in the morning, south in the afternoon, past Green Point. They apparently spend the night in the Strait of Juan de Fuca and forage in Rosario Strait and other areas to the north during the day.

Summer movements were similar, with Summer resident cormorants, gulls, Rhinoceros Auklets, Marbled Murrelets, and Heermann's Gulls moving north and south along Rosario Strait. Marbled Murrelets were consistently seen during the Summer at Green Point, Watmough Bay, Cypress and Lummi Island shorelines.

III-F-10. Region 10. San Juan Islands--Northern Waters

Gulls and alcids make up a significant proportion of the total numbers present, and large flocks feed in convergence areas. There are a few small nesting colonies within this region.

III-F-11. Region 11. San Juan Islands--Interior Channels and Passages

The deepwater passageways among the islands are characterized by low numbers and density throughout the year. Only in the southern San Juan Channel subregion (3) are there usually large numbers of birds, and then mainly in the Summer period. The groups include cormorants and Glaucous-winged Gulls and up to a thousand Rhinoceros Auklets, the last no doubt from the Smith/Protection Island colonies to the south in the Strait of Juan de Fuca.

Sea watch observations from Cattle Point (Figure 2) indicate that major north-south movements of birds pass this point. In Spring and Summer, relatively large numbers of loons, gulls, Pelagic Cormorants, and Rhinoceros Auklets move past this point. In Fall (October), large numbers of gulls, terns, and cormorants fly northward through San Juan Channel for about an hour after dawn.

III-F-12. Region 12. San Juan Islands--Interior Bays and Harbors

These subregions are a collection of shallow water areas within the San Juan Islands and, as expected, they contain larger numbers or concentrations of birds than the deeper channels and passages. Unfortunately, we have adequate data only for the Winter period. There is little doubt that the numbers and diversity in these areas in general follow the same trends seen throughout the study area; lower numbers and diversity during the Summer.

These areas are often frequented by foraging groups of Arctic Loons or Bonaparte's Gulls. These species are present at one site during one census and gone the next, not only in this region but also in Region 11. In the Winter period, the Bufflehead is by far the most abundant species followed by Great Scaups and scoters. Other important species are Horned and Western Grebes, Red-breasted Merganser, Mew Gull, and the Glaucous-winged Gull. Indeed, some of the bays are impressive with the array and numbers of each species that are present.

III-F-13. Region 13. Canadian Waters

The Active Pass subregion is a unique biological feature in itself. Area densities cannot be applied to other locations. Gulf Island waters represent densities probably typical of deepwater passages within the Gulf Islands.

During the Winter, Active Pass is often the site of large feeding flocks of Brandt's Cormorants and also Arctic Loons (see Vermeer 1977). These feeding flocks are apparently attracted to the available food, concentrated by large volumes of water moving through the narrow pass at the flow of the tides. The cormorants arrive in October and leave only in April/May. Our survey results are similar to the results of a study of Active Pass carried out intermittently from 1963 to 1976 (Campbell et al. MS). That study revealed that as many as 7,000 Brandt's Cormorants (also 4,000 seen by Vermeer, 1977) can be present in Active Pass or as few as 20 during the Winter. Our mean count of 16 censuses is 267±380 s.d. birds, but these are only samples of part of the Active Pass area; the average we project is 1,600 Brandt's Cormorants. For all species during the Winter our mean count is 672 and a projected area total of 4,030 birds of 27 species. Maximum counts ranged as high as about 3,000 each of Arctic Loons, Brandt's Cormorants, Bonaparte's Gulls and Common Murres in Active Pass.

III-G. Mortality

Dead Bird Censuses represent dead birds found as opposed to actual mortality. Not all birds float or wash ashore, and scavengers are numerous in the study area, especially during the Winter when both largest bird populations and greatest mortality occur. Eagles, gulls, crows, several carnivorous wild mammals and domestic dogs are widespread and are frequently observed. Most beached birds and fish are promptly found by scavengers and often carried off or altered beyond recognition; consequently, any mortality calculated from beached birds found is underestimated.

III-G-1. Beach Walks

Table 7 shows the number of beached birds found, the number of censuses, and the calculated rate of occurrence (dead birds/km/census). The number of dead birds found on beaches in our study area (Figure 3) is normally low and represents the small number that actually die and that are not found or moved by scavengers. Any sizable number of birds found together (or within a census location) is an indication of "abnormal mortality." The last occurs within our study area and often represents

Table 7. *Frequency of Dead Birds Found on Dead Bird Censuses of Selected Beaches (Figure 3)*

Site	Beach length(km)	Number censuses	Number birds	Number months	Censuses/ month	Rate[1] (birds/km/ census)
Bellingham Bay No. 1 (1)[2]	1.0	13	1	8	1.6	0.08
Bellingham Bay No. 2 (2)	2.3	14	2	10	1.4	0.06
Birch Bay No. 1 (3)	1.9	3	0	2	1.5	0.00
Cherry Point No. 1 (4)	1.9	3	0	1	3.0	0.00
Cherry Point No. 2 (5)	2.0	4	2	3	1.3	0.25
Clallam Bay No. 2 (6)	1.7	3	0	1	3.0	0.00
Clallam Bay No. 3 (7)	1.3	4	1	2	2.0	0.19
Crescent Bay No. 1 (8)	2.0	1	0	1	1.0	0.00
Deception Pass No. 1 (9)	1.1	11	1	8	1.4	0.08
Deep Creek No. 1 (10)	0.3	1	0	1	1.0	0.00
Drayton Harbor No. 1 (11)	1.9	5	14	5	1.0	1.47
Drayton Harbor No. 2 (12)	1.9	4	0	4	1.0	0.00
Dungeness Spit No. 1 (13)	5.4	14	6	8	1.8	0.08
" " No. 2 (14)	2.6	10	9	6	1.7	0.35
" " No. 3 (15)	2.6	10	7	6	1.7	0.27
" " No. 4 (16)	2.2	7	2	6	1.2	0.13
" " No. 5 (17)	2.0	7	3	6	1.2	0.21
" " No. 6 (18)	4.8	15	15	9	1.7	0.21
Green Point No. 1 (19)	0.6	4	2	4	1.0	0.83
Padilla Bay No. 1 (20)	0.5	5	1	5	1.0	0.40
" " No. 2 (21)	0.5	8	0	7	1.1	0.00
" " No. 3 (22)	0.5	4	2	4	1.0	1.00
Point Roberts No. 1 (23)	0.9	5	16[3]	5	1.0	3.56
" " No. 2 (24)	1.4	9	2	8	1.1	0.16
" " No. 3 (25)	0.6	1	0	1	1.0	0.00

Table 7. (Continued)

Site	Beach length (km)	Number censuses	Number birds	Number months	Censuses/ month	Rate[1] (birds/km/ census)
San Juan No. 1 (26)	1.9	8	1	4	2.0	0.07
San Juan No. 2 (27)	1.1	2	0	1	2.0	0.00
Voice of America (28)	0.9	10	3	7	1.4	0.33

[1] Rate: Number dead birds found per km of beach per census. This unit is independent of time, i.e., week or month. At present there is no way to calculate the number of dead birds that actually reach a stretch of beach in any unit of time, and we cannot measure the birds per month, week, etc., but just per census.

[2] Numbers in parentheses refer to specific numbered locations in Figure 3.

[3] Includes 12 Western Grebes found 26 August that probably died in fishing net.

mortality from disease or fish-net kills. Oiled birds to this date are rarely found. Time and personnel limitations resulted in minimal beach coverage in many areas of this study, except in a few locations where local volunteers provided a regular, intensive effort.

Our dead bird data indicate that under present conditions, the rate of occurrence varies from no birds to 3.56 dead birds/km/census. However, if the 12 Western Grebes (Table 7) are removed from the list the rate falls to 0.89. In that case, the upper rate observed is 1.47 dead birds/km/census. Generally, these values are somewhat lower than values from a similar study in 1975-1976 in southern California (Briggs pers. comm.), but there is considerable overlap. The southern California data are for dead birds/km/month and are thus, in many cases, directly comparable to our data.

In summary, it appears that the rates of occurrence of dead birds in this study area are somewhat lower than those of southern California. Perhaps the influence of pelagic water offshore and its associated birds explain the difference. In southern California, Sooty Shearwaters in particular and Fulmars and Black-legged Kittiwakes were found on the beaches in numbers. These species are not regularly recorded in our study area except in the Swiftsure Bank area.

The incidence of oiled birds is very low. If there were a major oil spill, Dead Bird Censuses and airplane/boat transect censuses together could certainly document a portion of any birds killed. Continued use of standard census sites can be used to monitor changes in mortality rates.

III-G-2. Transect Observations

While some dead birds may have been missed, we feel experienced observers see most that are floating within aerial or surface (boat) transect widths. Few dead birds were seen from air or moving boat censuses, but most of those that were seen were near commercial fishing activity. As noted above, scavengers find some of these casualties.

In addition to birds noted above, mortality in fish nets was observed from fixed point censuses at Point Roberts, and we received a few informal reports of kills of 20 to 50 birds on uncensused beaches. One fuel station operator at a marina reported hearing of several kills in fishing nets.

III-H. Effects of Human Activities on Marine Birds

The twentieth century has brought many changes to the oceanic and shoreline habitat of marine birds in Washington as well as other parts of the world. Many of these changes have been detrimental to seabirds whereas others have been beneficial. A better understanding of both the present and future status of marine birds in the study area can be received by discussing the above mentioned changes (for a review, see Manuwal 1978).

III-H-1. Detrimental Changes

III-H-1-a. Increased Marine Vessel Traffic. Areas experiencing increased traffic include Port Angeles Bay in particular, the northernmost part of Bellingham Bay, the Anacortes/Guemes Channel area, and the ferry routes. In many respects, some bird populations have adjusted to this and co-exist to a degree with such activities in many areas.

Recreational boating has been increasing steadily for years, particularly in the San Juan Islands, and since vessels are shallow draft and used virtually everywhere, this often poses serious problems for birds. Birds are disturbed primarily by interrupting their feeding or resting activities.

III-H-1-b. Disturbance at breeding colonies. Marine birds are probably most vulnerable to human disturbance during the breeding season. Actual vulnerability depends on the species, where it nests, the stage of nesting, and the kind of human activity.

Disturbance on and around nesting colonies has been increasing, even though many sites are designated and posted as refuges. Many "bird rocks" have adjacent kelp beds and/or convergence areas. These attract boaters and fishermen who in turn may disturb birds. Frightening adult birds off nests may very well result in broken or chilled eggs or subject eggs and young to predation and result in extensive nesting failures. This happens particularly in the easily accessible San Juan Islands areas and is most serious from June through August. Many of these same sites are used as Winter roosts by large numbers of cormorants and gulls as well as by harbor seals and sea lions and similar, though less frequent, disturbance results during the Winter season.

III-H-1-c. Physiological and psychological stress. During periods of severe weather, marine birds may be subjected to stress caused by inability to feed or withstand the physical abuse of wave and wind action. Under such conditions, birds may seek shelter in protected bays and channels. Boating disturbance at this time can be very detrimental. So far, however, boating disturbance in most shallow bays (particularly Padilla and Samish bays and Drayton Harbor) is minimal. Serious impact could result by allowing the use of shallow draft recreational craft in these areas, because of the disturbance to roosting and feeding birds. This type of activity, along with habitat destruction, appears to have been responsible for the extirpation of wintering brant populations from much of the coast of California and would be very detrimental to brant and other species here.

III-H-1-d. Commercial fishing. Commercial fishing has undoubtedly impacted bird populations within the area. Our informal observations and random reports from others suggest that a problem exists, that species affected are primarily Western Grebes and Common Murres, and that studies should be conducted to determine the extent of mortality and to suggest possible solutions or mitigations. In a 1975 policy statement, the Pacific Seabird Group states that in the North Pacific, the Japanese salmon gill-net fishing may have killed 4.7 million marine birds since 1952. Trollers and purse-seiners also account for unknown numbers of marine bird losses.

III-H-1-e. Habitat alteration. Local habitat alteration has been extensive within the study area, particularly in urban and industrial areas, and where marina and port facilities have been created by dredge-and-fill operations. Birds are consistently concentrated in areas where biological productivity is highest, and these are primarily the shallow bays, estuaries, and shelves. Many of these areas are also proposed to be significantly altered by port and marina development. Drayton Harbor, Bellingham Bay, Padilla Bay, Fidalgo Bay, Sequim Bay, and Jamestown are among the areas where not only birds but many marine food resources will be impacted by proposed actions which will eliminate habitat in the near future.

III-H-1-f. Oil pollution. Oil pollution is now a well-known threat to marine birds and mammals. Despite a rather voluminous literature on oiled birds that dates back to the 1920s (Vermeer and Vermeer 1974), we still have inadequate baseline data for most regions of the world, particularly here in Washington. We can make some generalizations based on avian mortality after documented oil spills. Vermeer and Vermeer (1975) summarize the major sources of oil pollution on marine birds. Most, if not all, of these sources have the potential for increasing in the study area if expanded oil facilities and transportation occur here. Bird species that are most vulnerable are those that either spend much time on the water surface or dive beneath it for food. Such birds include loons, grebes, cormorants, eiders, scoters, and alcids. Our BOI values reflect the vulnerability of these species to oil. Vermeer and Vermeer (1974, 1975) provide an extensive review of this aspect. In Washington, the major impact of oil pollution occurs during migration and Winter when large numbers of diving birds are present. However, the Rhinoceros Auklet is particularly vulnerable in the Summer breeding season because of its small number of breeding sites and its apparent localized but concentrated feeding areas.

III-H-2. Beneficial Changes

III-H-2-a. Artificial habitat. The presence of log rafts and pilings has provided gulls, guillemots, and cormorants with some additional nesting and roosting habitats. At this time however, only a small proportion of marine birds utilize this type of habitat. In some locations within our study area, dredge-spoil islands have created new nesting habitat, primarily for Glaucous-winged Gulls, Arctic Terns, Spotted Sandpipers, and Killdeer (Peters et al. 1978, Manuwal et al. in press). On the Atlantic and Gulf coasts of the United States, this kind of habitat is a significant replacement for lost colony sites (Soots and Parnell 1975).

III-H-2-b. Increased food supply. Bait and offal from the commercial fishing industry provide much food for shearwaters, Fulmars, and gulls in the offshore waters. In the Strait of Juan de Fuca and Puget Sound area, human garbage dumps have attracted large numbers of Glaucous-winged Gulls as well as many migratory gulls. While the increase in Glaucous-winged Gulls in Washington is noticeable, it is not as great as that observed in New England (Kadlec and Drury 1968). While this increase in gull populations is judged by many to be beneficial, there is abundant evidence that the increase has had a detrimental effect on other marine birds (see Manuwal 1978).

IV. SUMMARY AND CONCLUSIONS

IV-A-1. Seasonality

Nearly all species of birds are seasonal in their occurrence within the study area. In general, the Winter and Spring periods are marked by peak numbers of wintering species most of which depart the area in the late Spring and Summer for northern nesting areas. These species then return to the area starting in the Summer and Fall. A varying number of nonbreeding individuals of many species is encountered during the Summer. While there are many variations by subregions, there appear to be as many as ten times as many birds present in peak Winter-Spring periods as are present in Summer in heavily used parts of the study area.

The Summer period is generally characterized by low numbers of birds, except near breeding colonies and in the foraging areas utilized by breeding birds. The 34,000 breeding Rhinoceros Auklets of the Protection Island colony fan out over the Strait of Juan de Fuca-Inner region and other areas daily in their search for food, often many miles from the colony (i.e., Rosario Strait, the interior of the San Juan Island and past Port Angeles). Each evening the birds return to Protection Island and "stage" near it before going onto the island. This utilization pattern is different from those of wintering birds, and there are many areas heavily utilized in the Winter that are relatively unused during the Summer.

The Spring and Fall periods are not only the time of departure and arrival, respectively, of the wintering and breeding birds but also periods of migration of species that do not breed or winter here. Additionally, Winter residents and Summer residents that breed south or north of here pass through the area, reminding us of the importance of this area for both resident and transient individuals.

IV-A-2. Colonies and Roosts

Most marine birds nest on inaccessible islands and cliffs. Here the birds are generally safe from predators and human disturbance. Food is available near the colony for only a few species; most birds must fly several miles to productive feeding areas. Subregions with large numbers of breeding birds are shown on Table 2, and sites include Tatoosh Island, Protection Island, Smith Island, and islands of the south shore of Lopez Island and Rosario Strait. The species breeding in largest numbers in the study are Rhinoceros Auklet, Glaucous-winged Gull, Pigeon Guillemot, Pelagic Cormorant, Double-crested Cormorant, and Marbled Murrelet. (Pigeon Guillemot and Marbled Murrelet are widely distributed species and are estimated from breeding season distribution and densities). Currently estimated numbers of breeding pairs are given and are above 29,000 pairs (Table 2).

Roosts are similar to nesting sites except their main function is a place to rest, dry plumage (i.e., for cormorants this is absolutely critical), preen, and spend the night safe from predators and disturbance. Whereas the importance of nesting sites is obvious, safe roosting sites are just as important, even if often neglected in management plants.

IV-A-3. Feeding Areas

Shallow water areas, such as shelves and estuaries are generally important foraging areas to birds. This is clearly seen in the various tables and figures of this report. In contrast, the deep open water areas and passages are generally characterized by lower numbers and diversity, but there are occasional exceptions.

Upwellings and tidal convergences are important sources of food, especially for fish-feeding birds. The productivity of tidal confluence sites varies according to tidal movements and are thus utilized intermittently by birds. Examples of these areas include Rosario Strait, Admiralty Inlet, Speiden Channel, southern San Juan Channel and Active Pass.

The special phenomenon of the Spring Herring spawn deserves attention. Very large numbers of scoters are annually attracted to this superabundant food supply. The largest concentrations of scoters at spawning areas occur at Cherry Point and Discovery Bay. While further analysis is to be conducted during the second year's study, the importance of the phenomenon to birds feeding on spawn (especially scoters and gulls) is readily apparent from our data (Appendix IV). Observations further suggest that the importance of herring to marine food webs is also indicated by large numbers of fish-eating birds (loons, alcids) in the Cherry Point area during the herring run season. Since scoters and Arctic Loons, for example, concentrate in the area in very large numbers during Herring spawn season just prior to their departure for northern nesting areas, reduction or elimination of herring populations could well have serious effects on marine bird populations over a large part of the continent.

IV-A-4. Interchange Between Areas

Bird species may be either highly sedentary or highly mobile, in the last case, moving from area to area as the opportunity for foraging varies. Consequently, no bay, estuary, or coastal area is isolated. Western Grebes, for example, may remain in a small traditional area for an entire Winter. Scoters on the other hand often remain in various locations for most of the Winter but then move to Herring spawning areas in the Spring. Common Murres seem to move almost continuously from one foraging area to the next. Cormorants move considerable distances between roosts and foraging areas within our study area. This means that subregions are linked together and effects of alternations or catastrophes in one subregion often cannot be separated from effects in another. Thus, cormorants roosting on Whale Rocks (Lopez Island, south shore) may move 35 km each way daily through Rosario Strait to forage in estuaries like Padilla. Similarly, daily movements of Rhinoceros Auklets from Protection Island to southern Admiralty Inlet, Rosario Strait, or

San Juan Channel illustrate interdependence of nesting and forating locations and daily flight tracks of up to 50 km each way.

On a different scale, the study area is heavily used as a stopover location during Fall and Spring migration. Even though many birds stay only a short time, the study area is a crucial link in coastal marine habitats of the Americas.

IV-A-5. Bird Oil Indices

Bird species differ in many biological attributes such as nesting, foraging, social behavior, and response to floating oil. An analysis of these attributes is important in not only assessing the "value" of each species but also of marine habitat such as bays, shorelines, channels, and passages.

To this end we developed the Bird Oil Index (BOI) (see Appendices II and V) in order to evaluate the importance and vulnerability to oil pollution of the various subregions. Thus, birds with larger populations, high fecundity, widespread feeding distribution, small scattered nesting areas, widespread Winter distribution, nocturnal land roosts, occur in small flocks or singly, and fly from danger (instead of diving) are less "valuable" or "important" and vulnerable to oil than species with opposite characteristics. The Bird Oil Index should only be used when evaluating the effects of oil. Take note, however, that we believe all bird species are worthy of protection regardless of their BOI values. The BOI ratings thus identify species particularly significant within the study area due to behavior, abundance, both on range and regional bases, and vulnerability. Species scored high because of these factors include Arctic and Red-throated Loons, Western Grebe, Brandt's and Pelagic Cormorants, Black Brant, White-winged, Surf and Black scoters, Black Oystercatcher, Common Murre, Pigeon Guillemot, Marbled and Ancient murrelets, and Rhinoceros Auklet. These are all either diving birds or very specialized as to diet (brant) or habitat type (oystercatcher).

Many other species using the area are of interest and concern. Species which are widespread and relatively versatile are also of significance to the area. Great Blue Heron, many species of swans, geese, ducks, shorebirds, gulls, and terns are important components of the avifauna and are vulnerable as individuals. Further, the Bald Eagle is an important predator/scavenger within the study area, and the Peregrine Falcon occurs regularly but in relatively small numbers. These species are often only peripherally involved with the water and shore edge, yet there is no doubt that they are part of the overall food chain dynamics. Populations of the Bald Eagle and Peregrine Falcon in our study area are probably larger than any other marine ecosystems in populated North America. The would certainly, and likely seriously, be affected by major oil spills.

IV-A-6. Subregion Rankings

After each subregion was rated for both BOI and BOI/km^2 for each season (Appendix VI), we averaged these ratings and ranked each subregion in one of five rankings (Table 8). The average rating intervals for each rank are: 1, >0 - 2; 2, >2 - 5; 3, >5 - 8; 4, >8 - 11; and 5, >11. A subregion's rank was increased by one if it contained significant roosting sites, nesting colonies, or foraging areas (see Table 9). The seasonal subregion rankings for each region, except Region 1, are displayed graphically in Figures 15 through 25.

IV-A-7. Areas of Significant Importance

After one field year of study, we can now identify certain areas (subregions and regions) of significant importance (Table 9). This listing is taken from ratings in Table 8 and reflects the importance of subregions and regions for nesting, roosting, and foraging marine birds. This list will be commented upon and refined and possibly expanded at the conclusion of the second year of study (1979).

This study of the seasonal distribution and abundance of marine birds is the most extensive ever conducted in this region. It is clear, however, that previous attempts to describe through literature review the status of marine birds in Washington have not adequately depicted the true situation. Errors and inconsistencies have been perpetuated in these previous reports. Our report is based only on one field season, so our conclusions should be interpreted to be tentative. More information is needed to assess the annual variations that normally occur in marine bird populations. Nevertheless, our data presently reveal many of the important biological characteristics of the marine avifauna that are useful in making future energy-related management decisions.

Table 8. *Seasonal Rankings of the Subregions of the Study Area*

Subregion Code	Name	Season Spring	Summer	Fall	Winter
0101	Swiftsure Bank	--	4	4	--
0201	Strait of Juan de Fuca (outer)	3	3	5	4
0202	Vancouver Island	2	--	3	2
0203	Cape Flattery	(5)[1]	5	(5)	3
0204	Neah Bay	2	2	2	2
0205	Neah Bay to Clallam Bay	2	3	3	2
0206	Clallam Bay	2	2	3	2
0207	Clallam Bay to Crescent Bay	3	2	3	3
0208	Crescent Bay	2	2	2	2
0209	Crescent Bay to Ediz Hook	3	2	3	3
0301	Strait of Juan de Fuca (inner)	3	2	4	4
0302	Ediz Hook	2	2	[3][2]	[3]
0303	Port Angeles	2	2	2	3
0304	Voice of America	3	3	3	3
0305	Dungeness Spit	2	2	3	2
0306	Dungeness Bay/Harbor	3	2	3	3
0307	Jamestown	4	4	4	5
0308	Sequim Bay	2	1	2	2
0309	Miller Peninsula	2	2	2	3
0310	Protection Island	(5)	(5)	(5)	2
0311	Discovery Bay	3	1	3	4
0312	Quimper Peninsula	2	2	4	3
0313	Whidbey Island	--	--	2	2
0314	Smith Island	(4)	(4)	(4)	3
0315	Deception Pass	2	2	2	2
0316	Lopez Island (south shore)	(4)	(4)	4	[5]
0317	San Juan Island (south shore)	2	--	3	2
0318	Victoria, Vancouver Island	--	--	--	4
0401	Admiralty Inlet	2	(3)	(3)	2
0501	Bellingham Channel	(4)	(4)	4	[4]
0502	Guemes Channel	2	--	--	2
0503	Fidalgo Bay	2	2	2	3

Table 8. *(Continued)*

Subregion Code	Name	Season Spring	 Summer	 Fall	 Winter
0504	Padilla Bay	5	1	4	5
0505	Samish Bay	5	2	4	5
0506	Bellingham Bay	3	2	4	5
0507	Hale Passage	[3]	2	1	2
0601	Lummi Bay	5	2	3	4
0602	Cherry Point	5	2	2	2
0603	Birch Bay	4	2	3	3
0604	Semiahmoo Spit	4	2	4	4
0605	Drayton Harbor	3	2	3	3
0606	Boundary Bay	4	3	4	5
0607	San Juan Islands--Northern Tier	2	(3)	(3)	4
0608	Georgia Strait--Eastern	3	2	3	4
0701	Pt. Roberts	4	2	2	4
0702	Tsawwassen Bay	5	2	3	3
0703	Georgia Strait--Western[3]	2	1	1	1
0801	Northern Haro Strait[4]	2	3	2	2
0802	Southern Haro Strait[4]	1	1	2	2
0901	Southern Rosario Strait	(4)	(4)	(4)	[4]
0902	Central Rosario Strait	2	(2)	(4)	3
0903	Northern Rosario Strait	3	(3)	4	3
1001	President Channel	2	2	3	3
1002	Northern Areas	2	1	2	3
1101	Speiden Channel	1	1	2	2
1102	Northern San Juan Channel	1	1	1	2
1103	Southern San Juan Channel	2	4	3	3
1104	Wasp Pass	2	2	2	2
1105	Upright Channel	1	2	2	2
1106	Harney Channel	1	1	1	2
1107	Obstruction Pass	--	--	--	2
1108	Thatcher Pass	1	2	2	2
1201	Mosquito/Roche Complex	2	2	3	3

Table 8. (Continued)

Subregion Code	Name	Season Spring	Summer	Fall	Winter
1202	Friday Harbor	1	1	--	2
1203	Griffin Bay	2	--	--	4
1205	Fisherman Bay	--	--	--	3
1206	Swifts/Shoal Bays	--	--	--	2
1207	Deer Harbor	--	--	--	2
1208	West Sound	--	--	--	2
1209	East Sound	--	--	--	2
1210	Lopez Sound	--	--	3	--
1301	Active Pass	3	1	2	3
1302	Canadian Gulf Islands	1	1	1	3
1303	Sidney Approach	2	3	3	3

[1] ( ) Breeding colony effect.
[2] [ ] Concentrations, roosting, local movement, foraging.
[3] Does not reflect adjusted values from Table 8.
[4] Does not reflect adjusted values from Table 9.

Table 9. Areas of Significant Importance[1]

Location	Comments
CAPE FLATTERY	A major nesting area of greatest diversity in study area is located on Tatoosh Island.
STRAIT OF JUAN DE FUCA-OPEN WATERS	During the late Summer and Fall, this area contains particularly large numbers of Common Murres.
DUNGENESS BAY/HARBOR to PROTECTION ISLAND	The shoreline area is heavily used by a variety of diving birds and waterfowl. Protection Island holds the largest nesting population of sea birds in the study area, most of which are Rhinoceros Auklets.
SMITH ISLAND	An important nesting and foraging area.
SOUTH SHORE LOPEZ ISLAND, OFFSHORE ISLANDS AND ROCKS	A major colonial bird nesting area composed of several small islands that are also heavily used as roosting sites by non-breeding and wintering birds.
ROSARIO STRAIT	The rocks and small islands in this area are important nesting sites and roosting areas for nonbreeding and winter birds. Tidal convergences are important foraging areas.
PADILLA, SAMISH AND BELLINGHAM BAYS COMPLEX	These biologically productive areas are important for migrant and wintering diving birds, waterfowl, and nonbreeding congregations of various species.
LUMMI BAY	An estuary of importance to wintering and migrant birds.
CHERRY POINT	During the Spring Herring spawn period huge numbers of birds forage between Hale Passage and Semiahmoo Spit.
BOUNDARY BAY	An important area for wintering and migrant birds.
POINT ROBERTS	A rich foraging area during the Winter and also in Spring during periods of Herring spawn.

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[1] Data from 1979 reveal that Admiralty Inlet, Region 4, is of Significant Importance during the Summer and early Fall periods at least. About one-third of the Rhinoceros Auklets breeding on Protection Island feed in and pass through this area daily. Many other species also use this area.

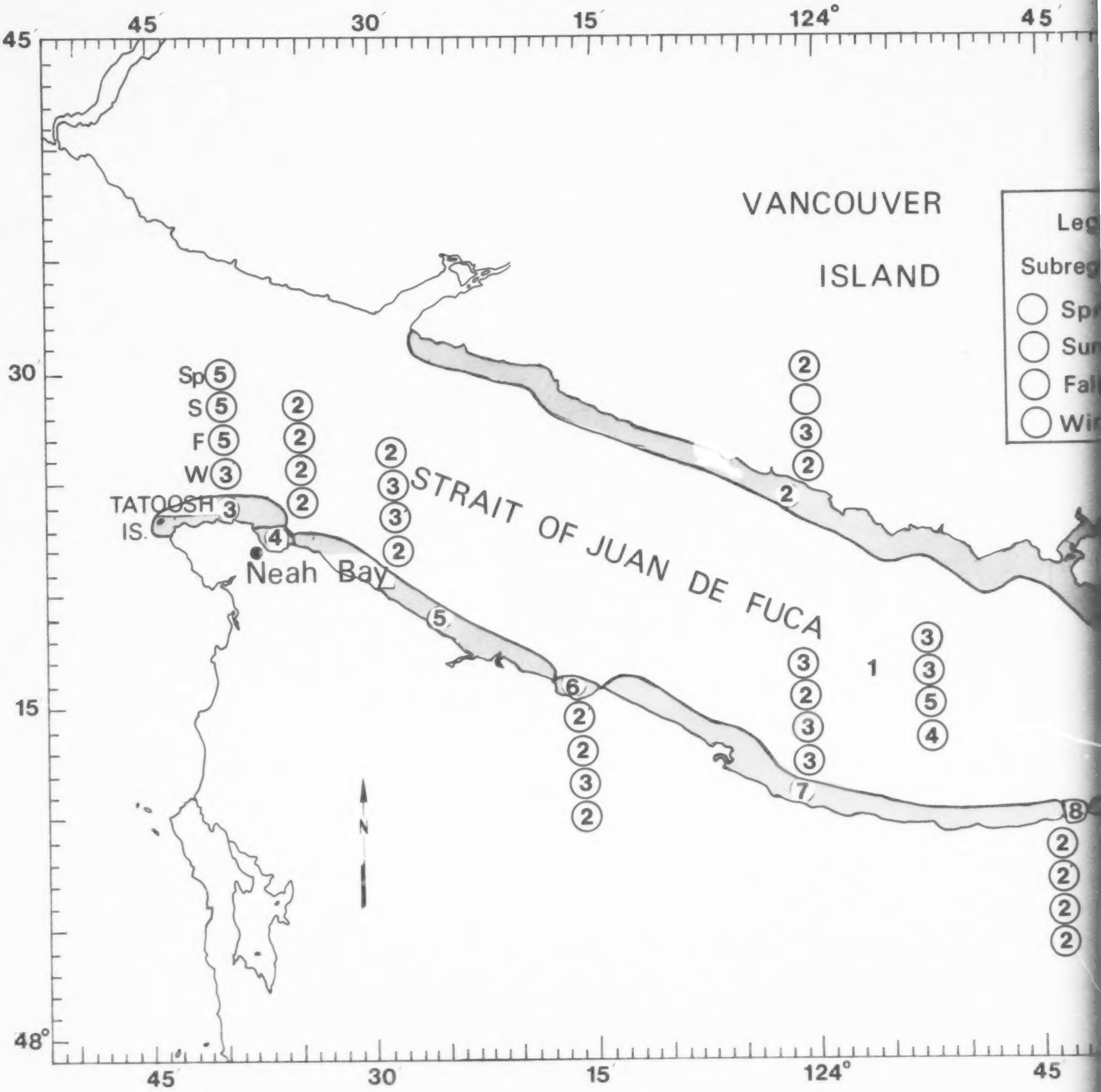

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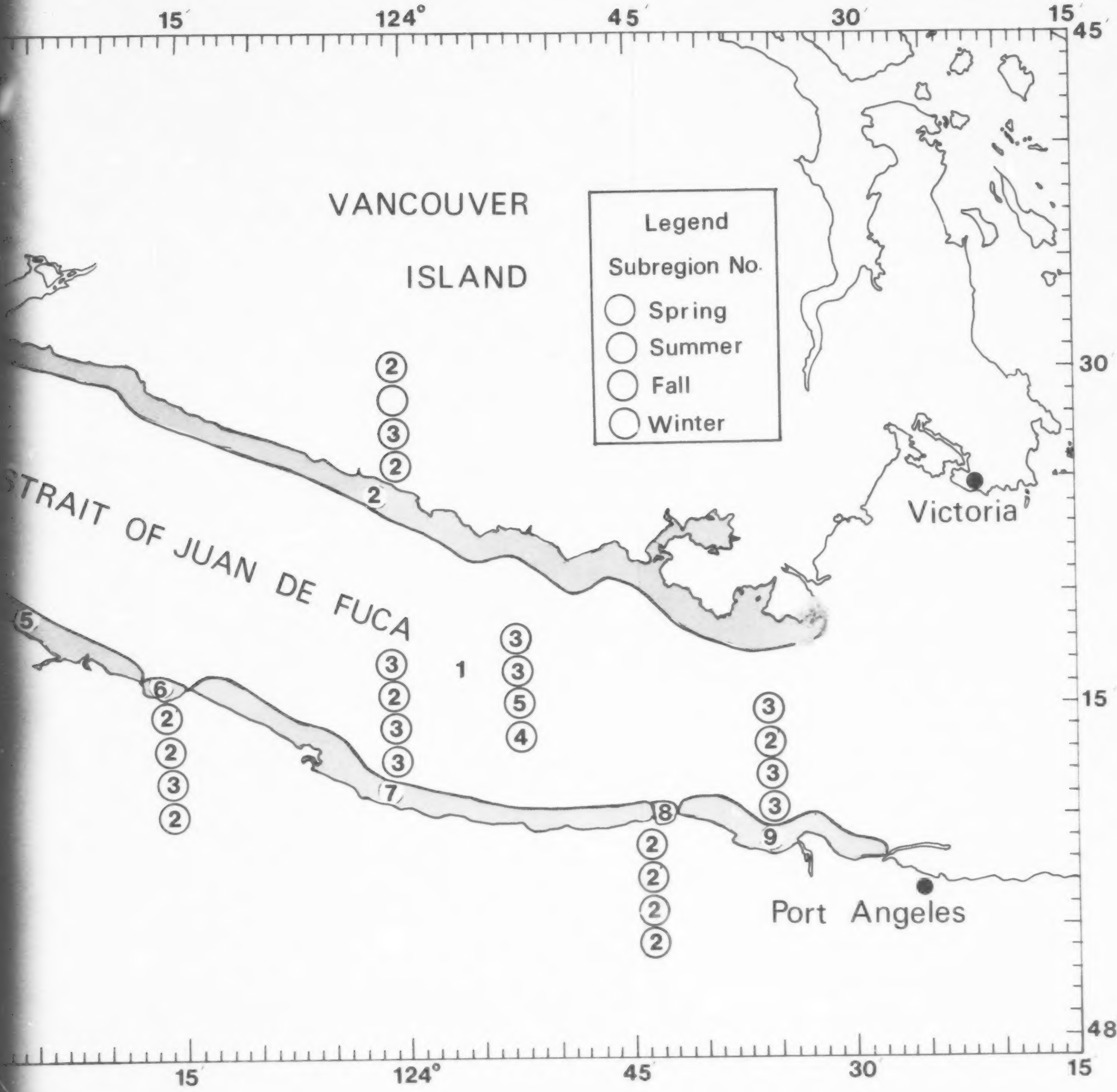
FIGURE 15. OVER-ALL SEASONAL RANKINGS FOR REGION 2



1/300,000

IGURE 15. OVER-ALL SEASONAL RANKINGS FOR REGION 2.

85/86

B

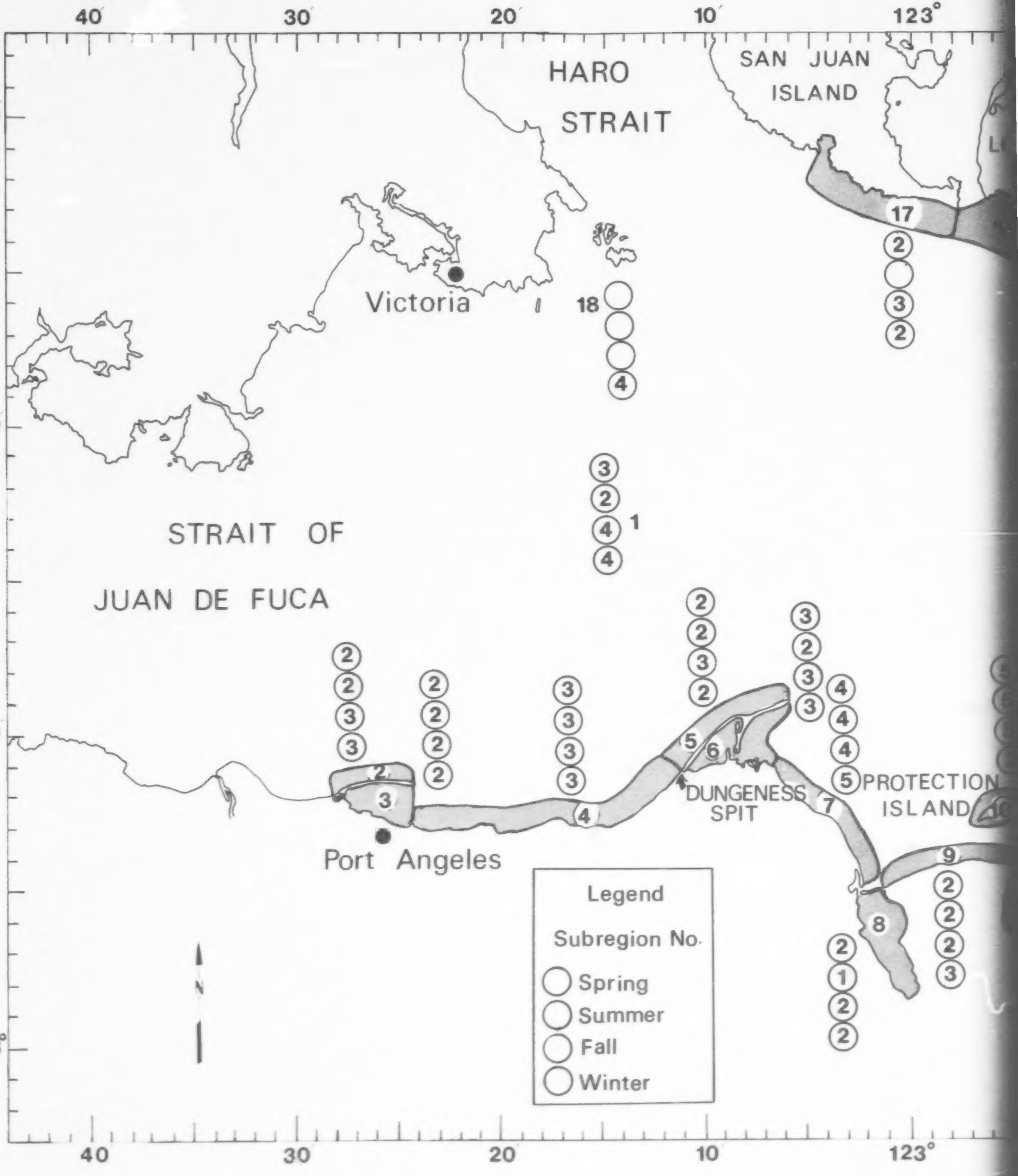


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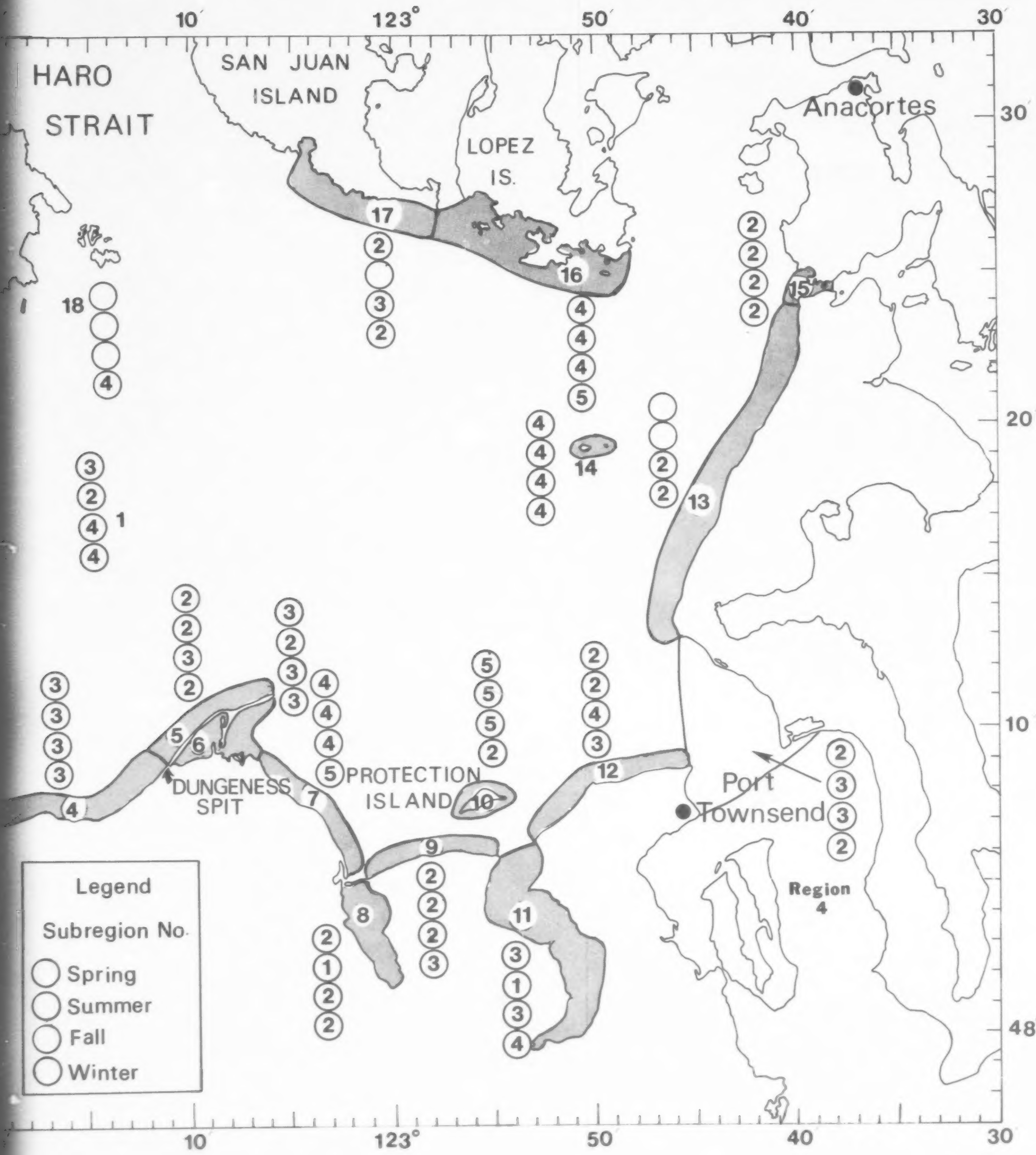
FIGURE 16. OVER-ALL SEASONAL RANKINGS FOR REG



6. OVER-ALL SEASONAL RANKINGS FOR REGIONS 3 AND 4.

87/88

B

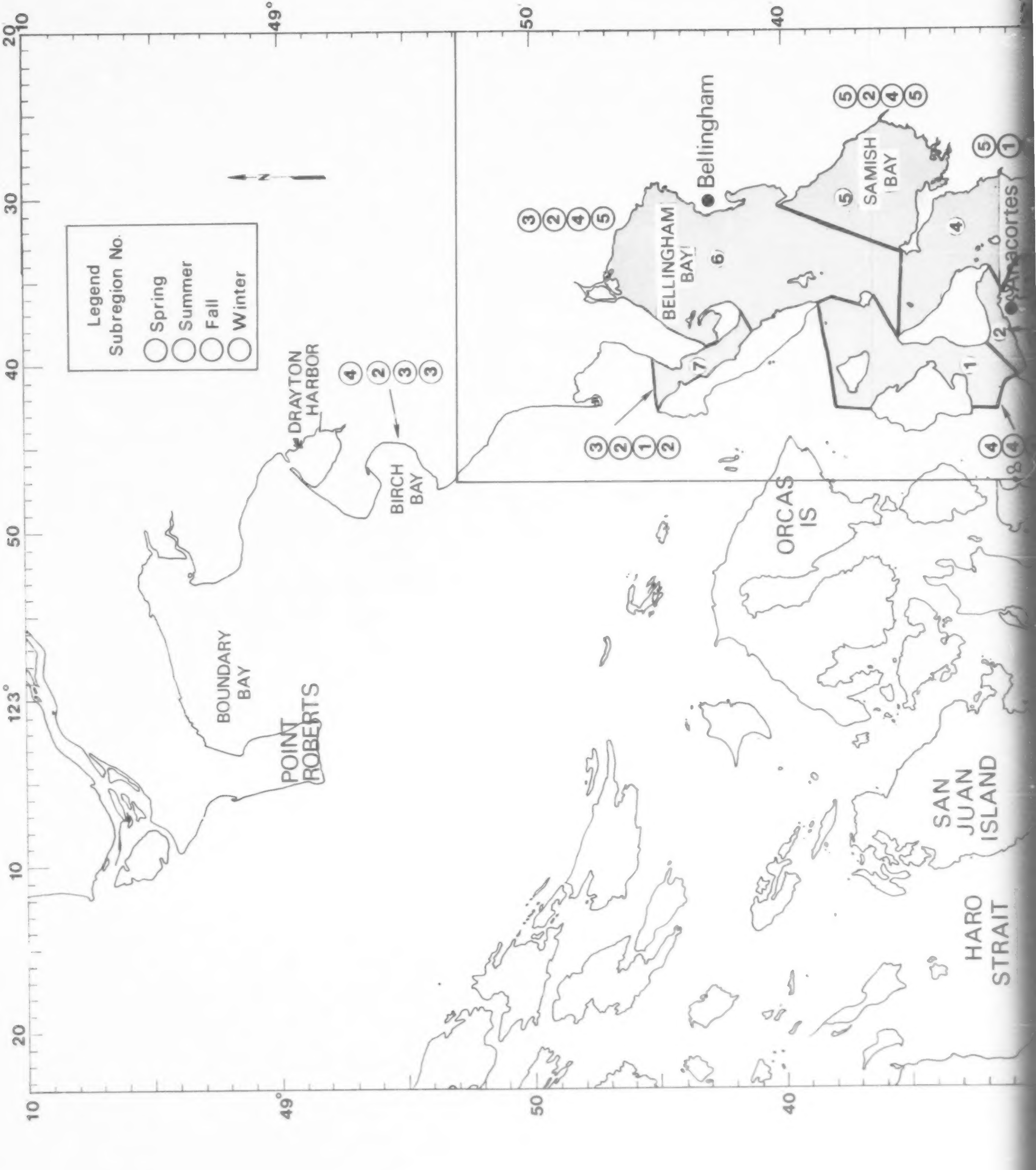


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FIGURE 17. OVER-ALL SEASONAL RANKINGS FOR REGION 5.

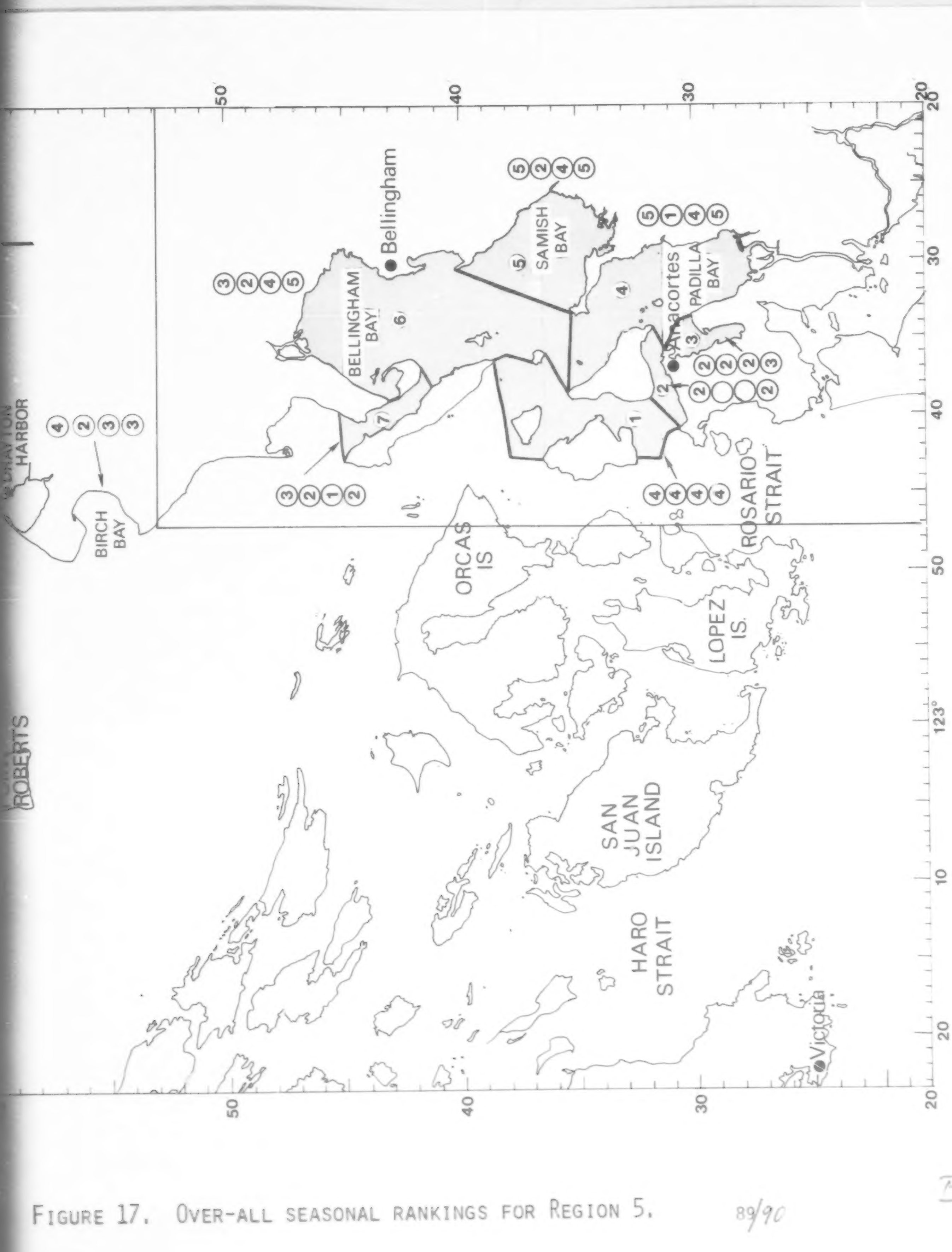

FIGURE 17. OVER-ALL SEASONAL RANKINGS FOR REGION 5.

89/90

B

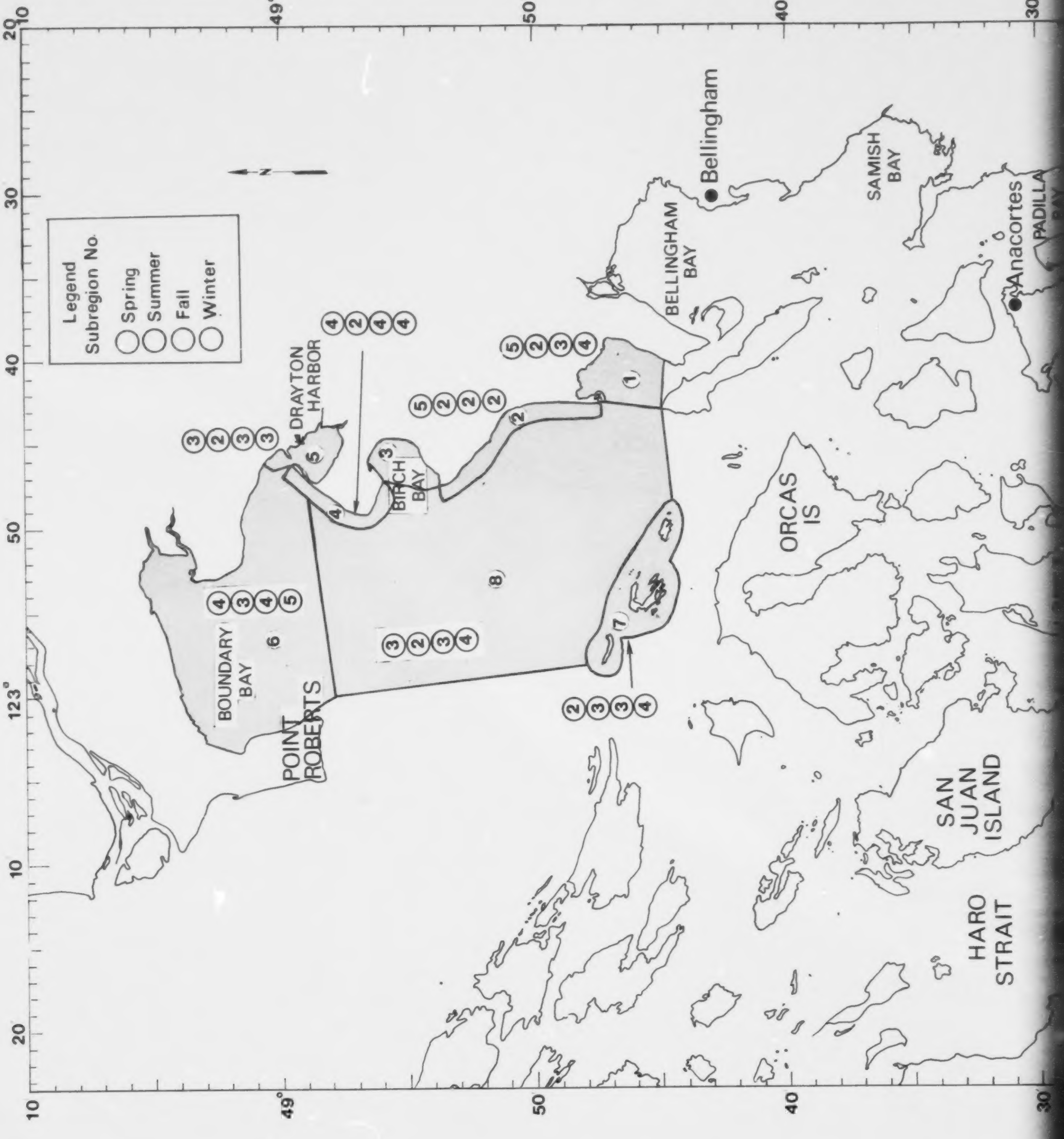

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FIGURE 18. OVER-ALL SEASONAL RANKINGS FOR REGION 6.

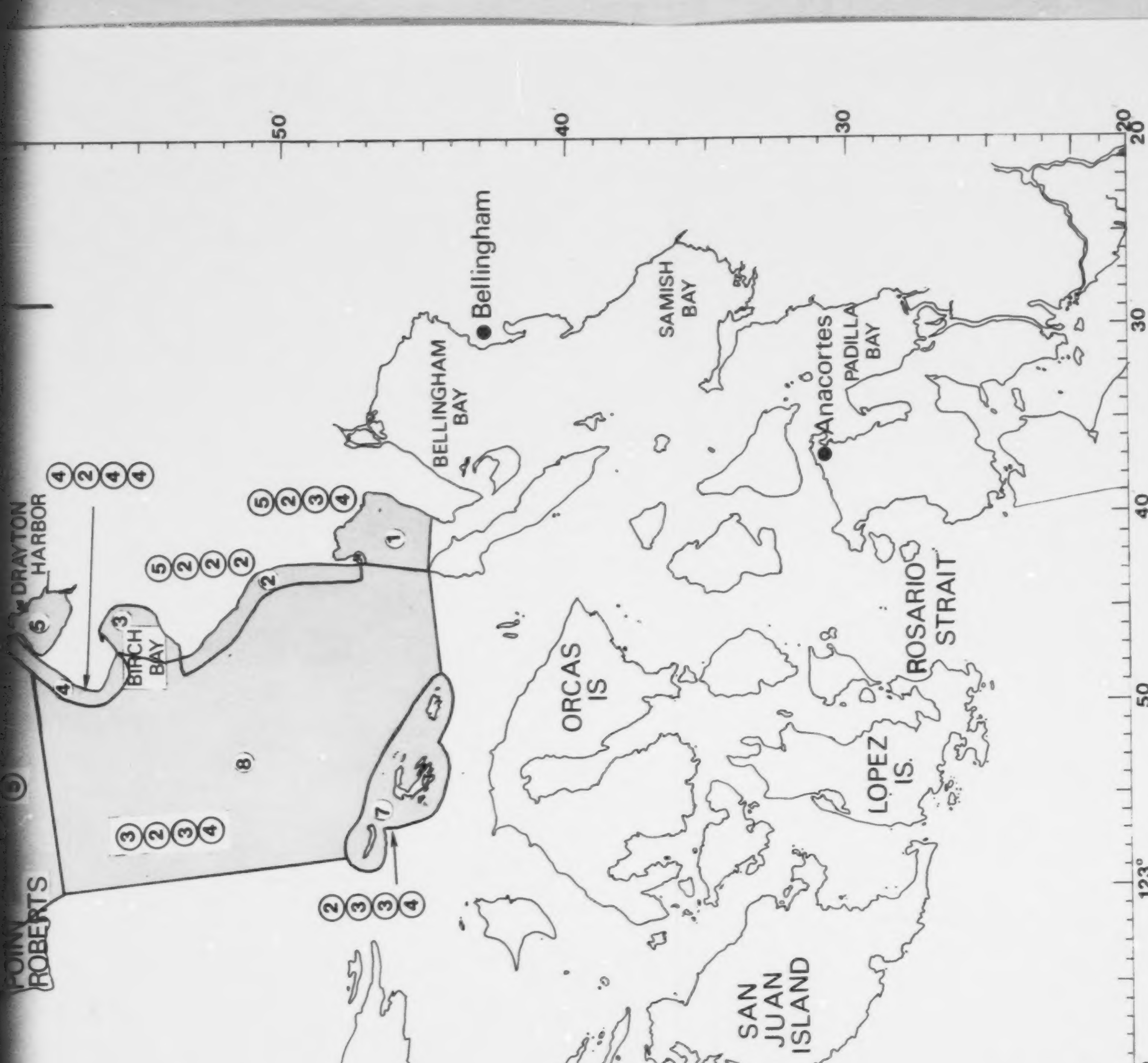

FIGURE 18. OVER-ALL SEASONAL RANKINGS FOR REGION 6.

91/92

B

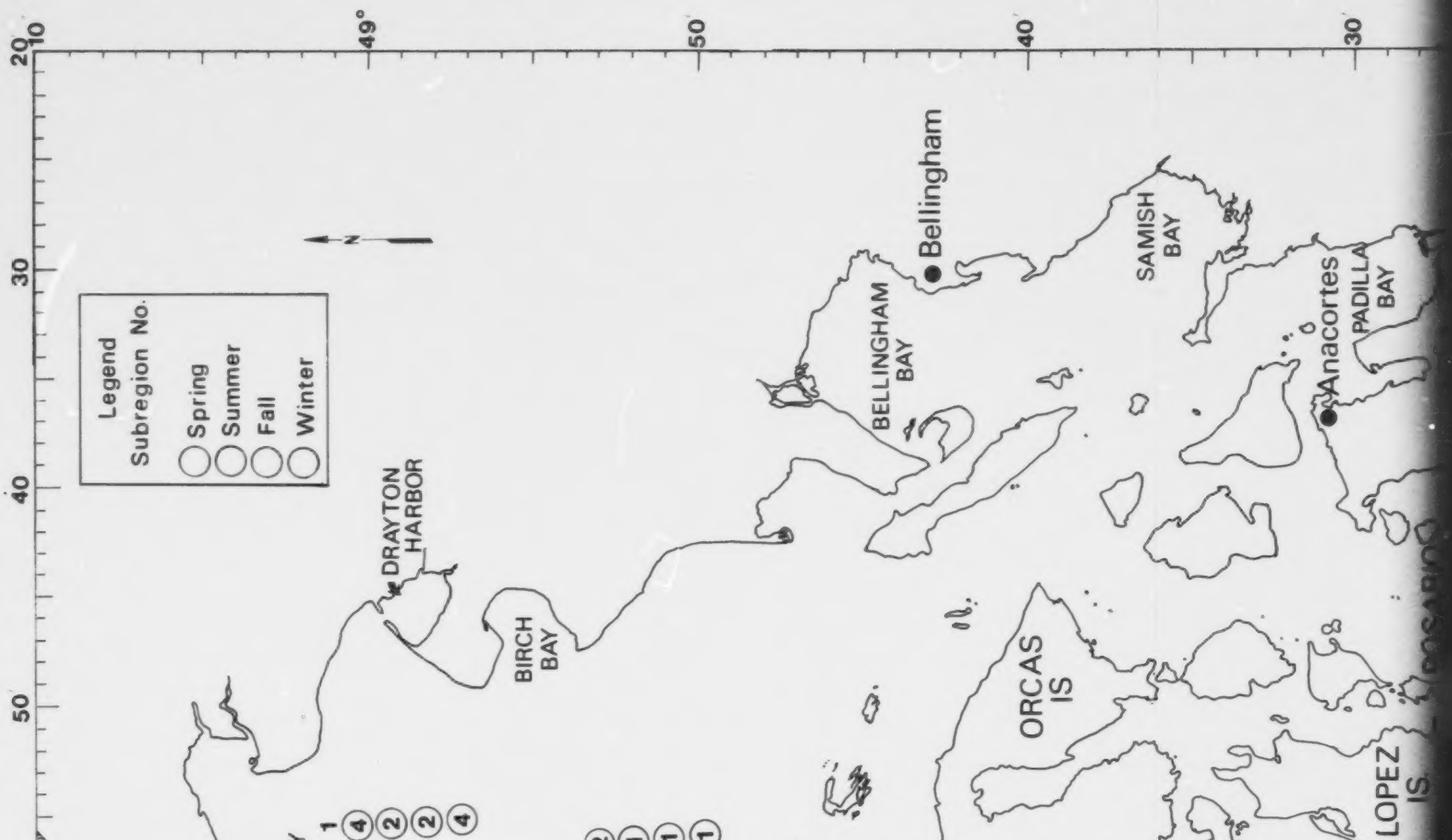

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FIGURE 19. OVER-ALL SEASONAL RANKINGS FOR REGION 7.

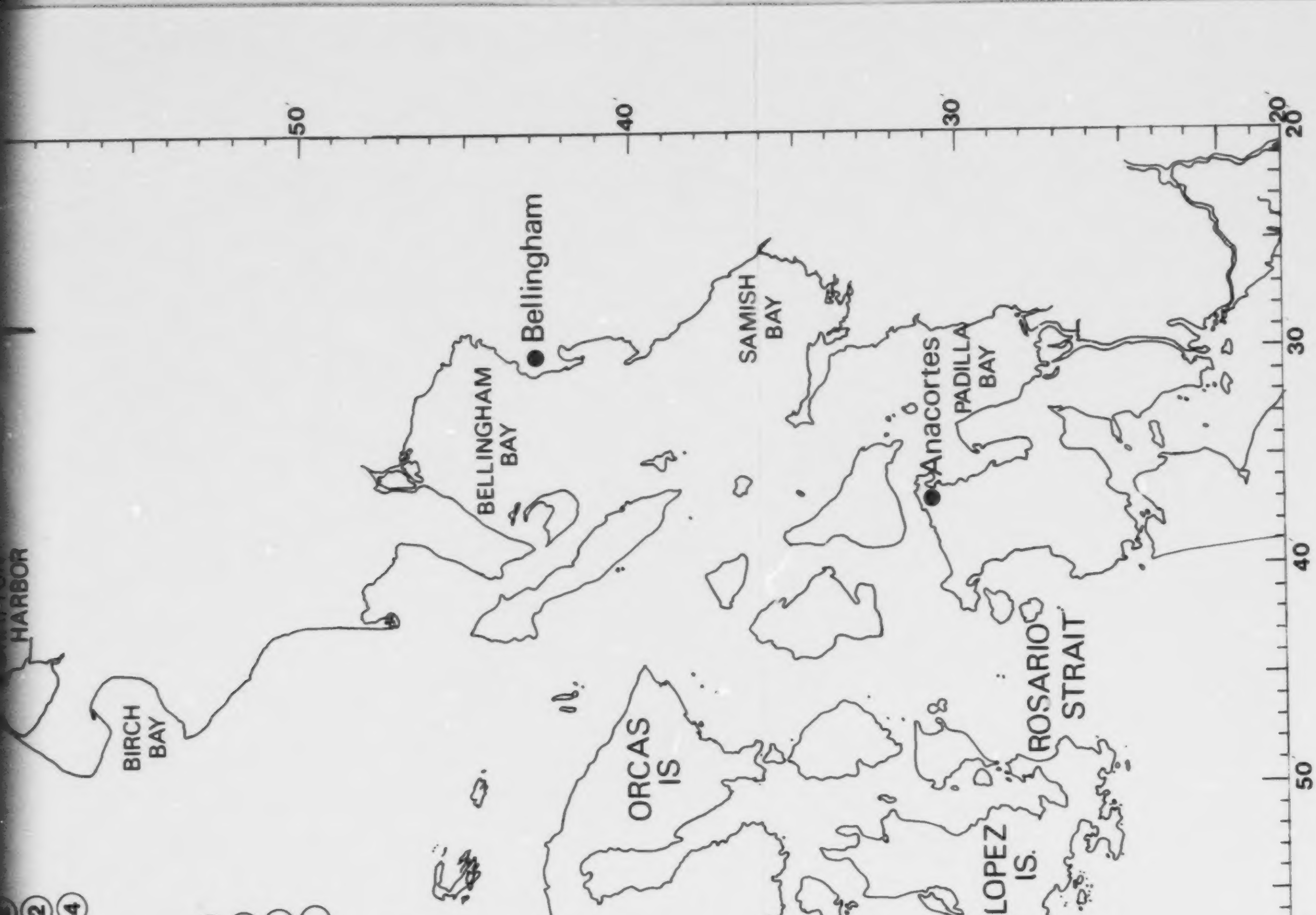

FIGURE 19. OVER-ALL SEASONAL RANKINGS FOR REGION 7.

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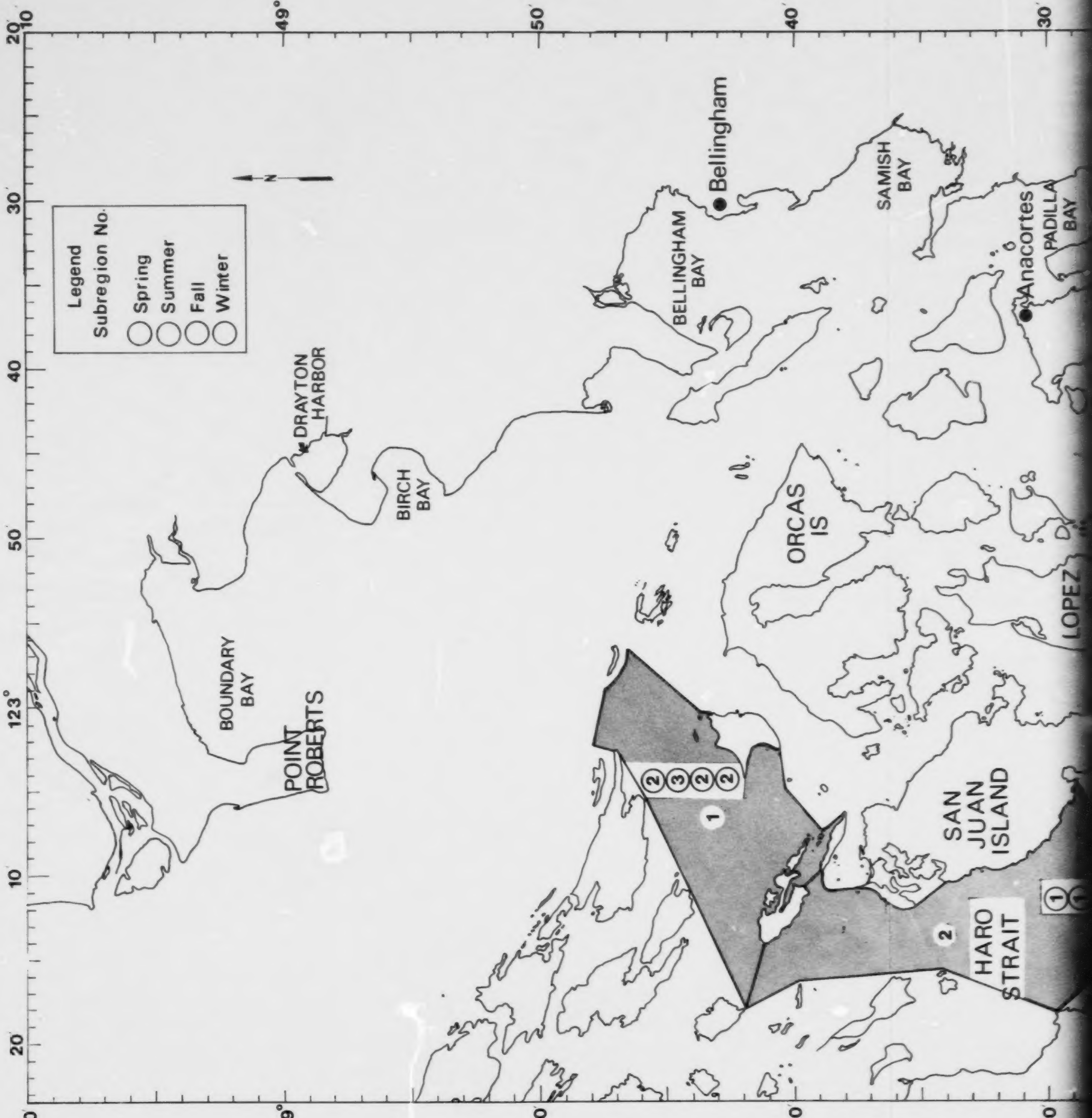

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Figure 20. Over-all seasonal rankings for Region 8.

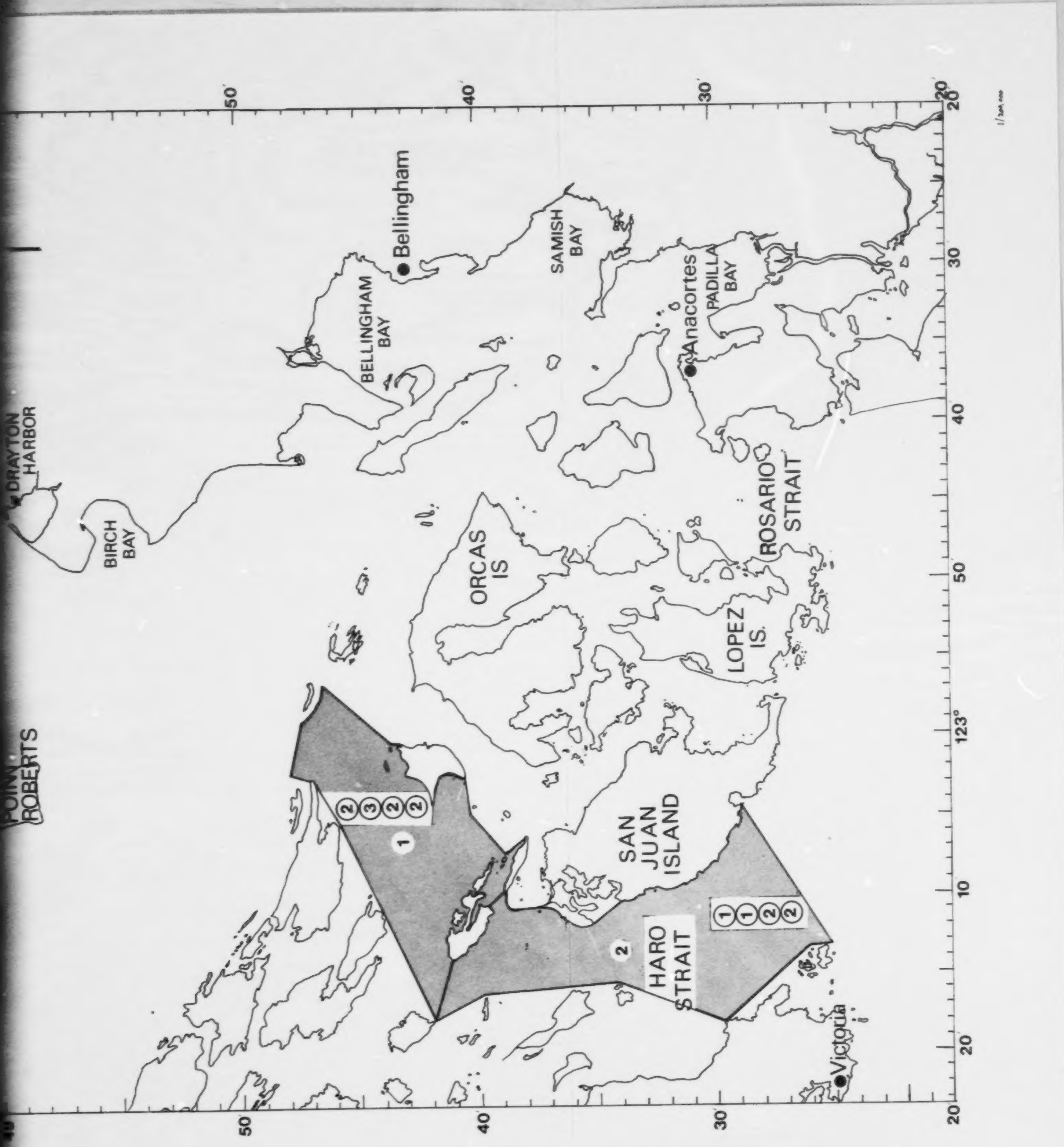

FIGURE 20. OVER-ALL SEASONAL RANKINGS FOR REGION 8.

95/96

B

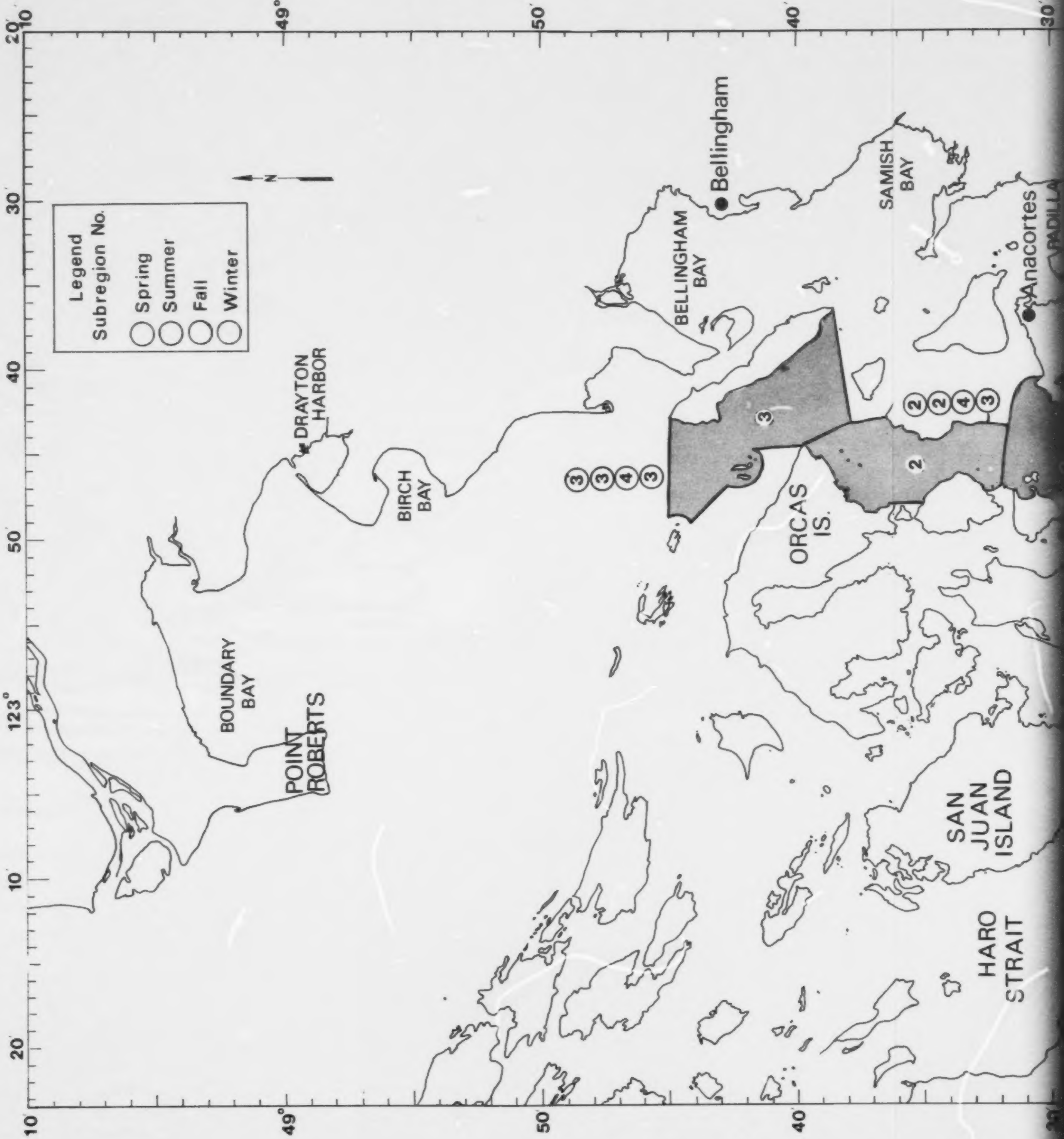

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FIGURE 21. OVER-ALL SEASONAL RANKINGS FOR REGION 9.

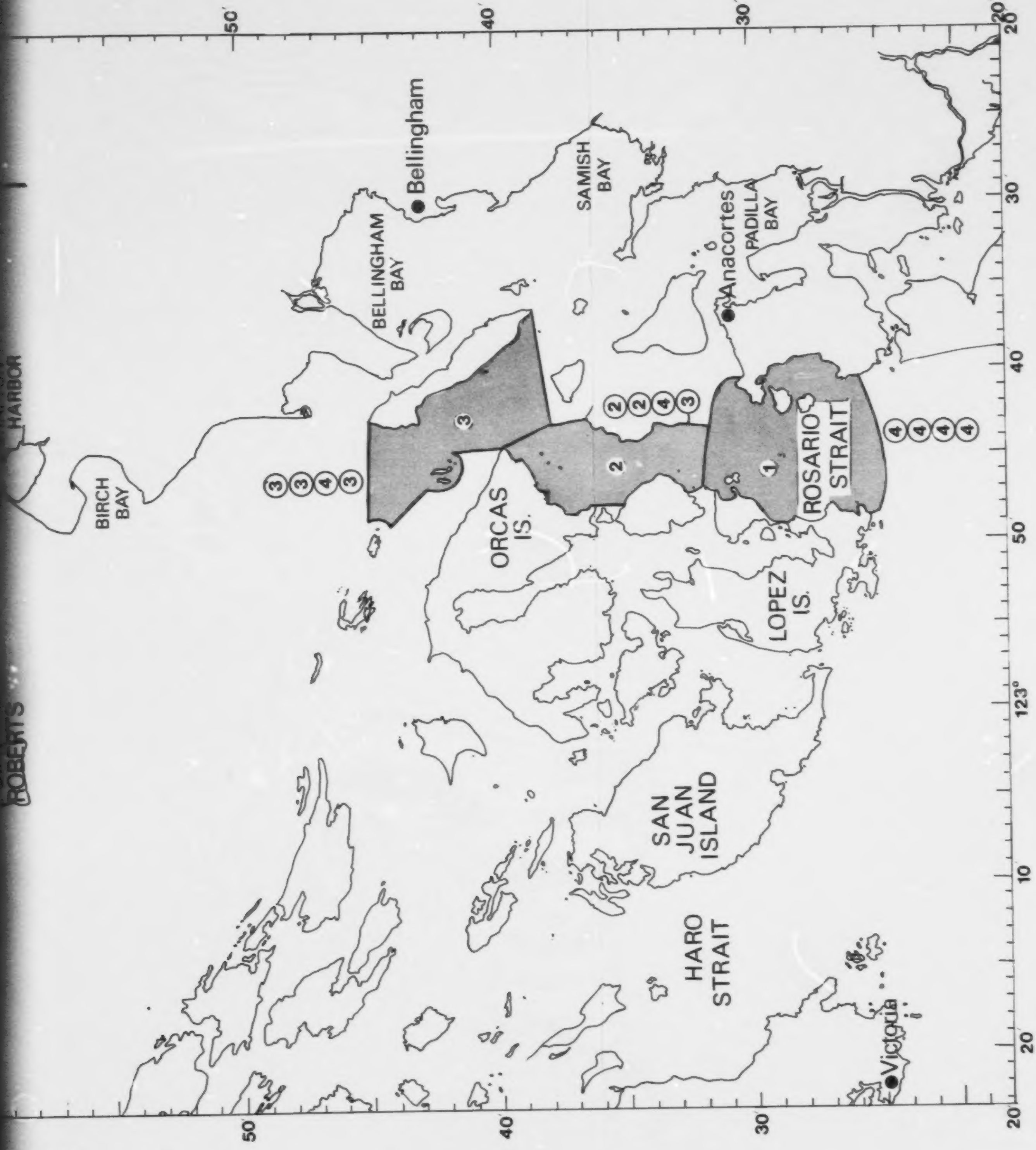
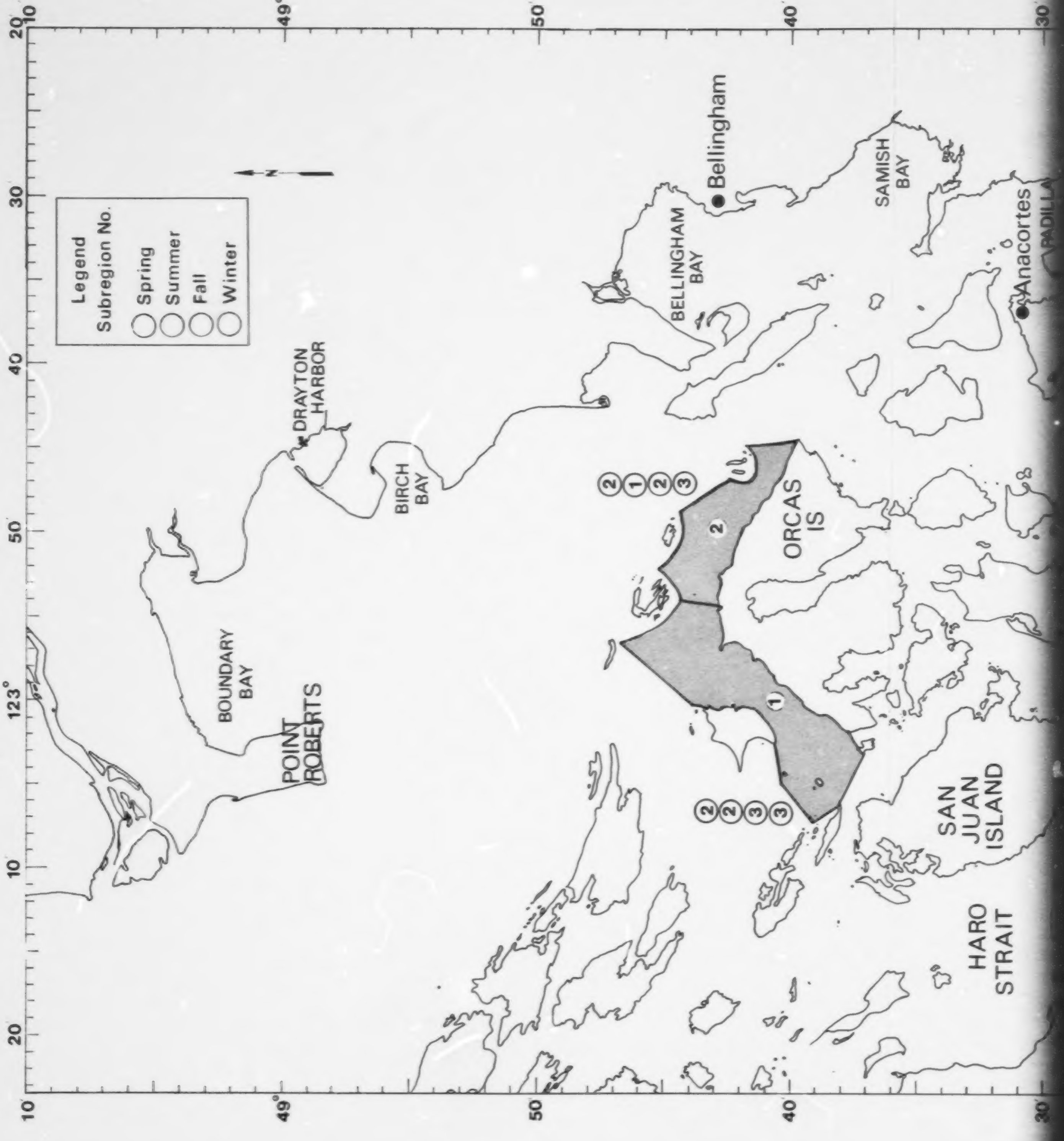


FIGURE 21. OVER-ALL SEASONAL RANKINGS FOR REGION 9.

97/98

B



A

FIGURE 22. OVER-ALL SEASONAL RANKINGS FOR REGION 10.

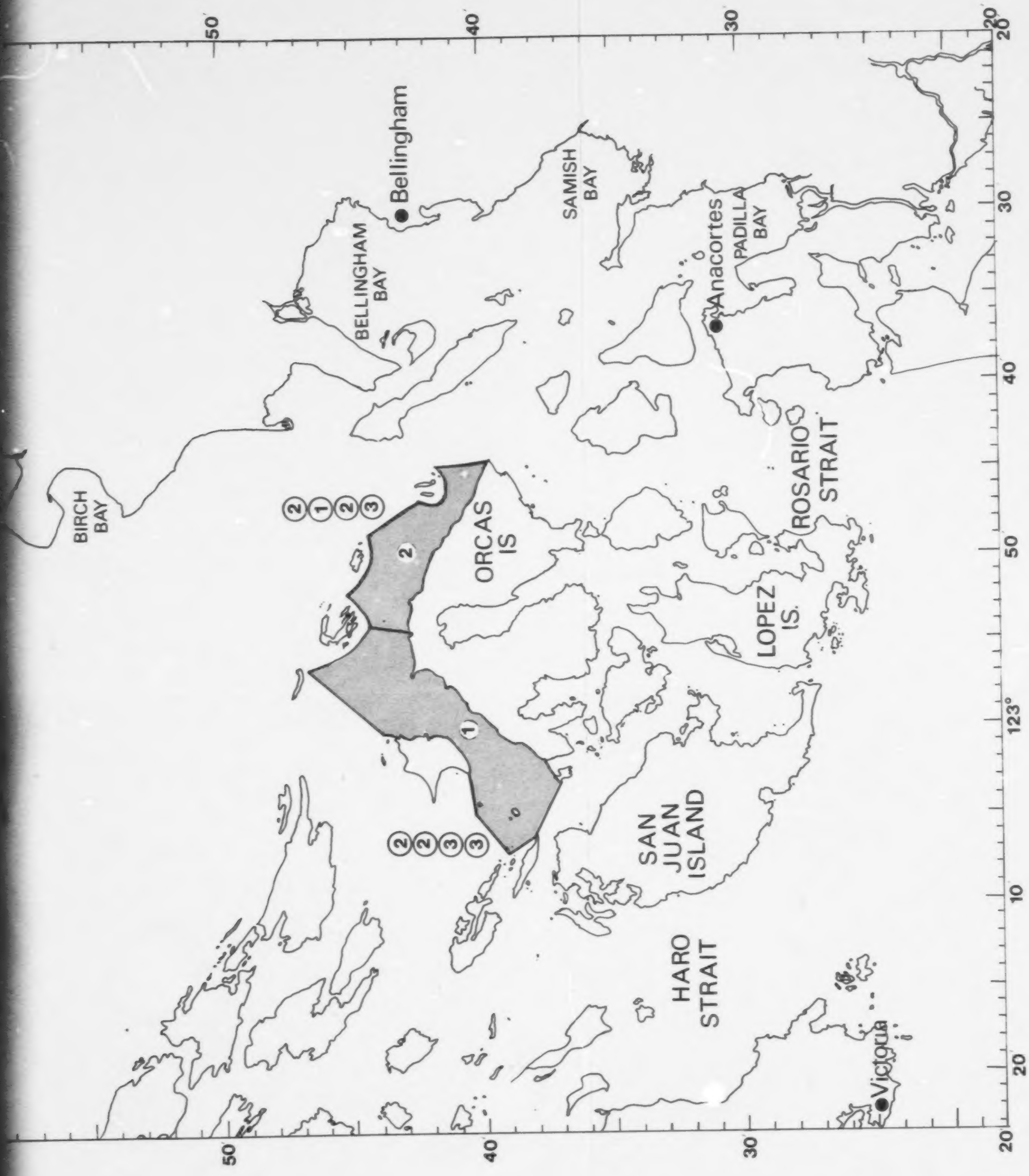
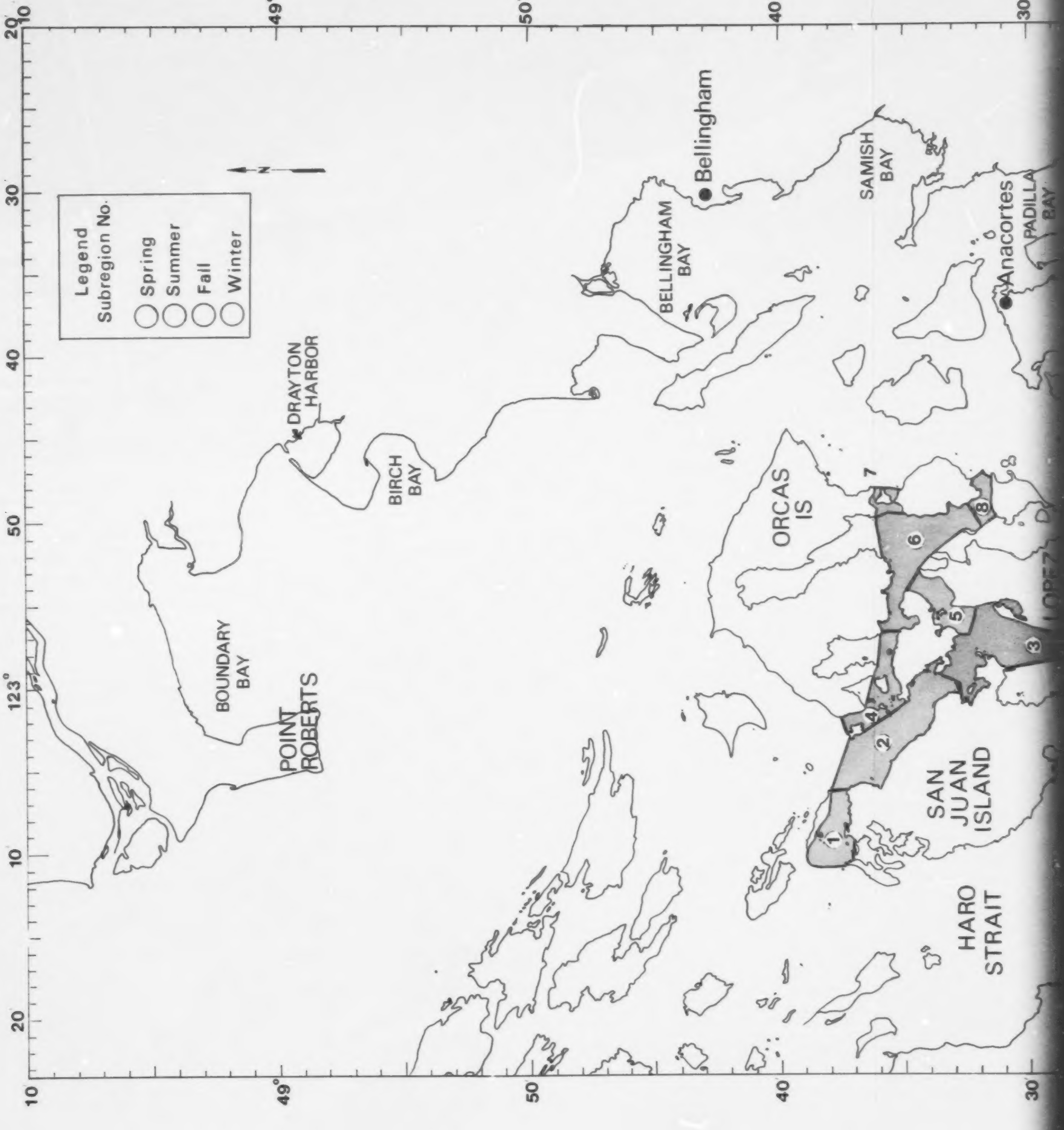


FIGURE 22. OVER-ALL SEASONAL RANKINGS FOR REGION 10.

99/100

B



A

FIGURE 23. OVER-ALL SEASONAL RANKINGS FOR REGION 11.

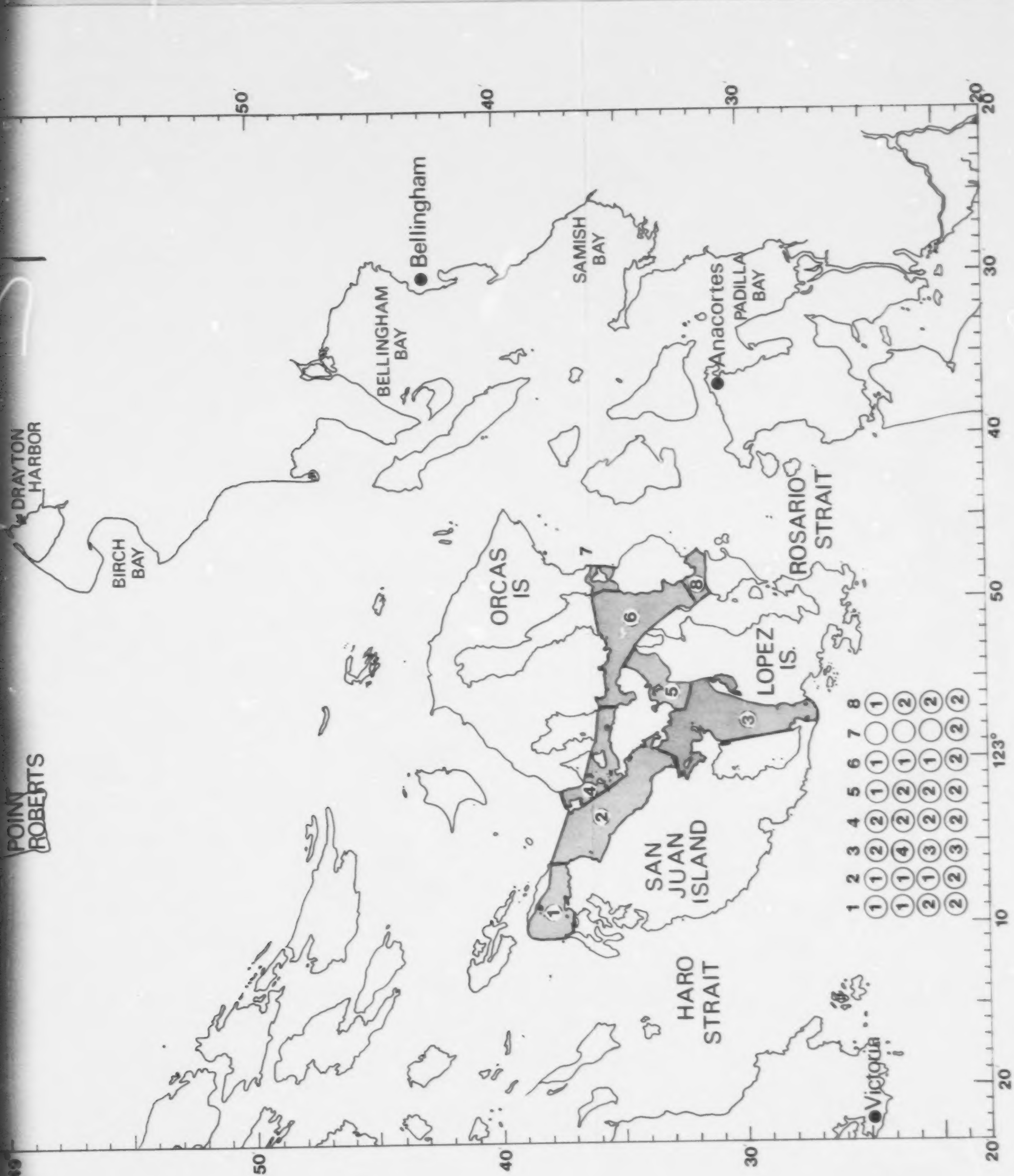
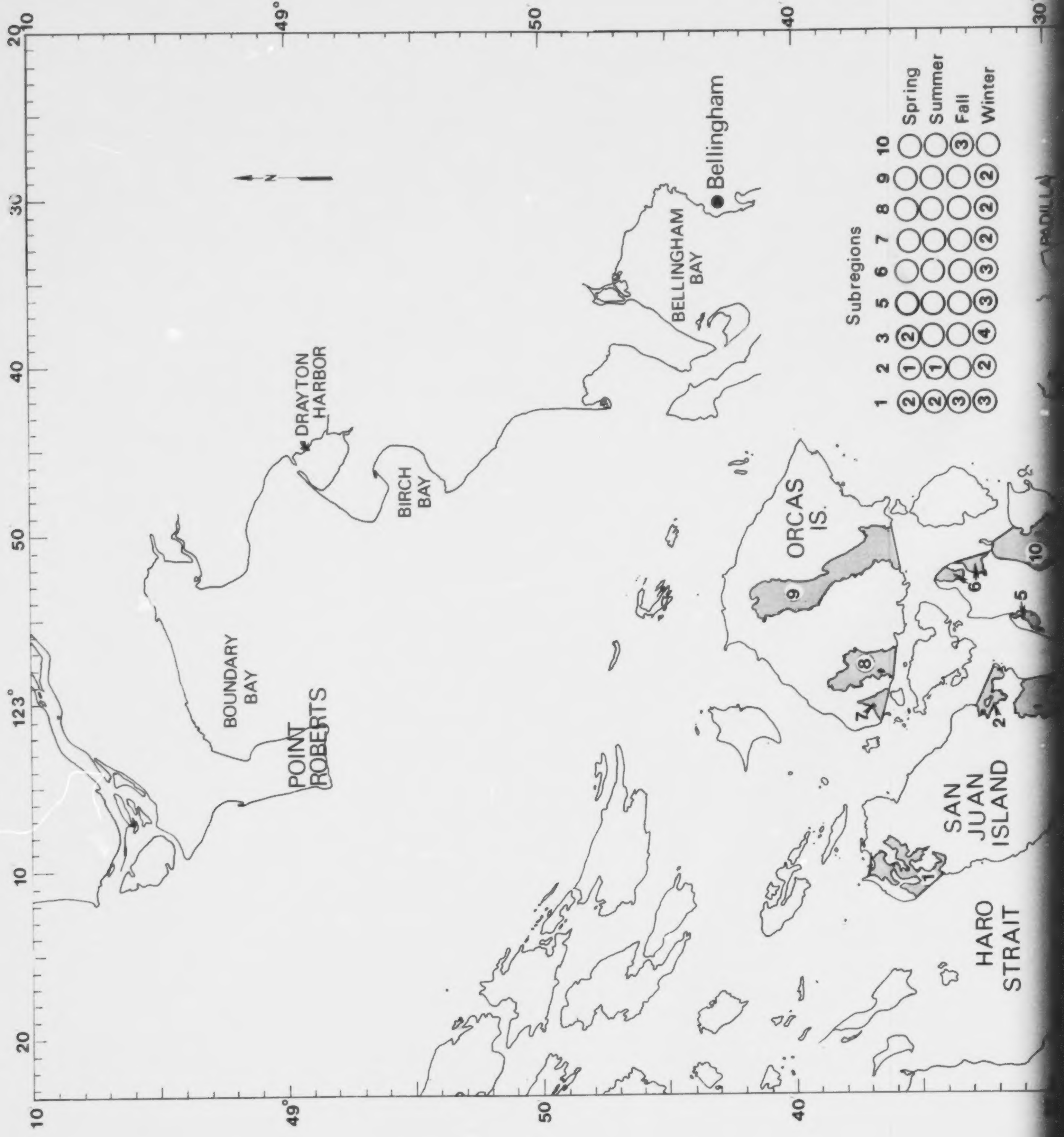


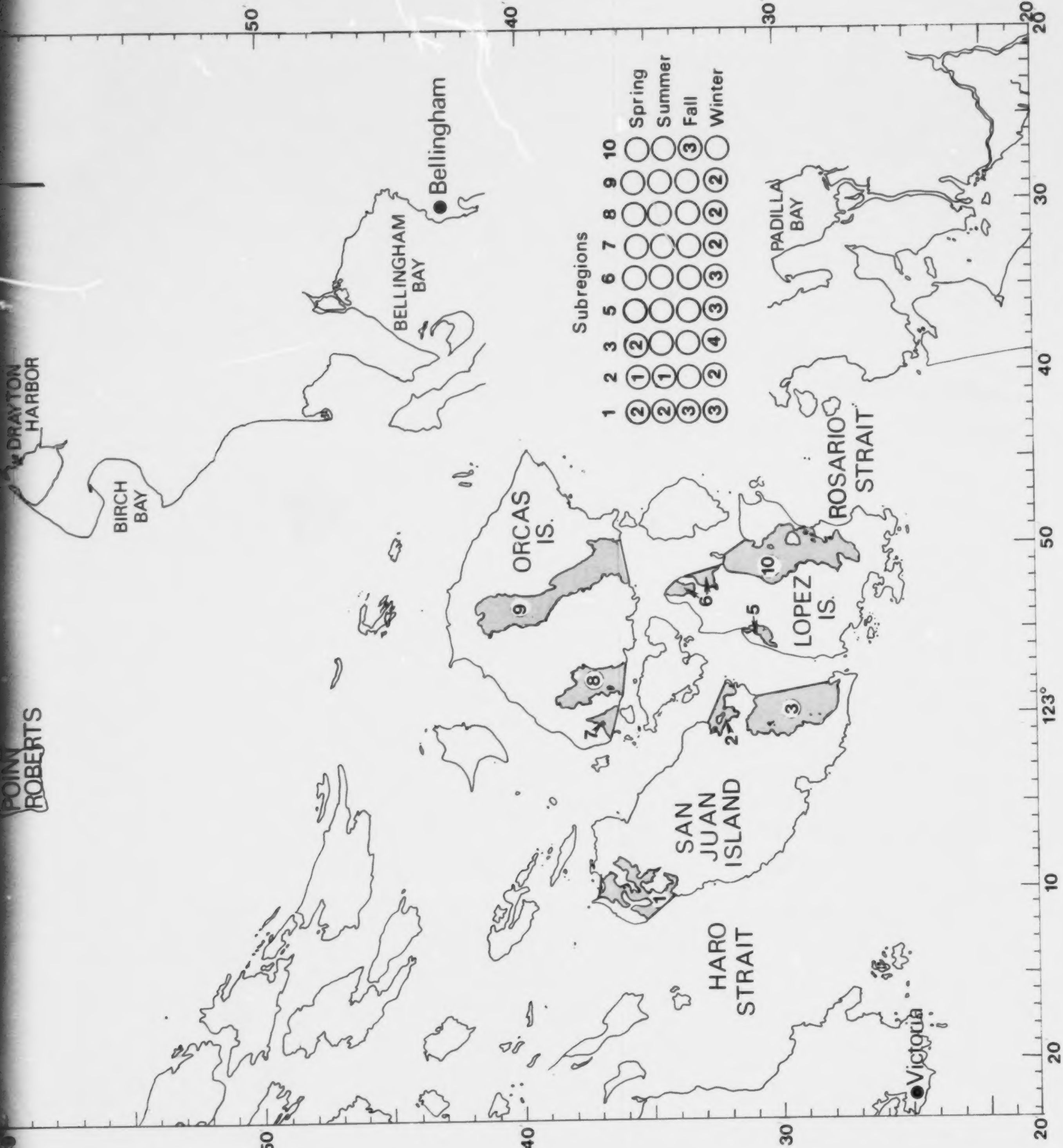
FIGURE 23. OVER-ALL SEASONAL RANKINGS FOR REGION 11.

B



A

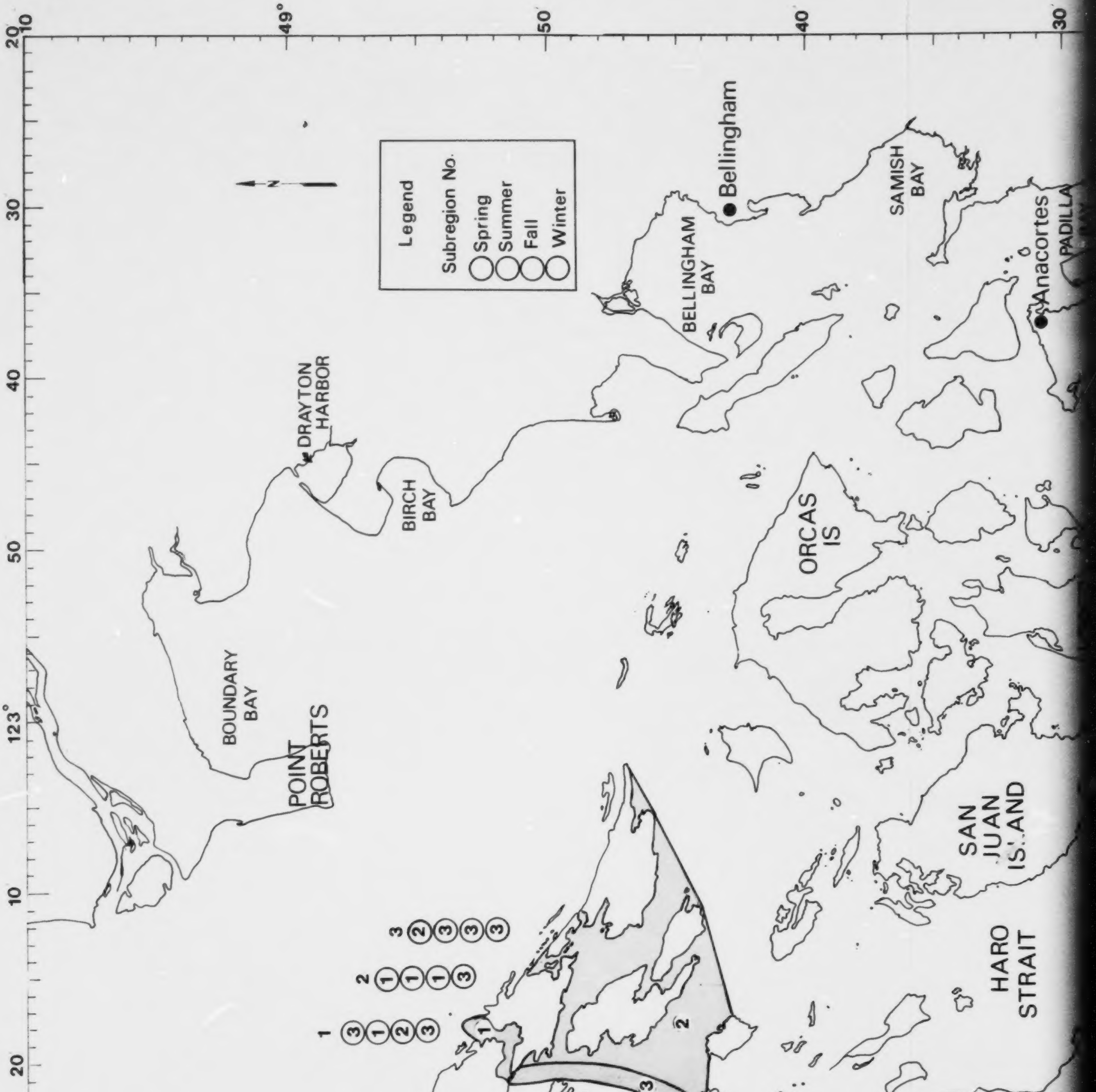
FIGURE 24. OVER-ALL SEASONAL RANKINGS FOR REGION 12.



Subregions	1	2	3	5	6	7	8	9	10
Spring	2	1	2						
Summer	2	1							
Fall	3								3
Winter	3	2	4	3	3	2	2	2	

B

FIGURE 24. OVER-ALL SEASONAL RANKINGS FOR REGION 12.



A

Figure 25. Over-all seasonal rankings for Region 13.

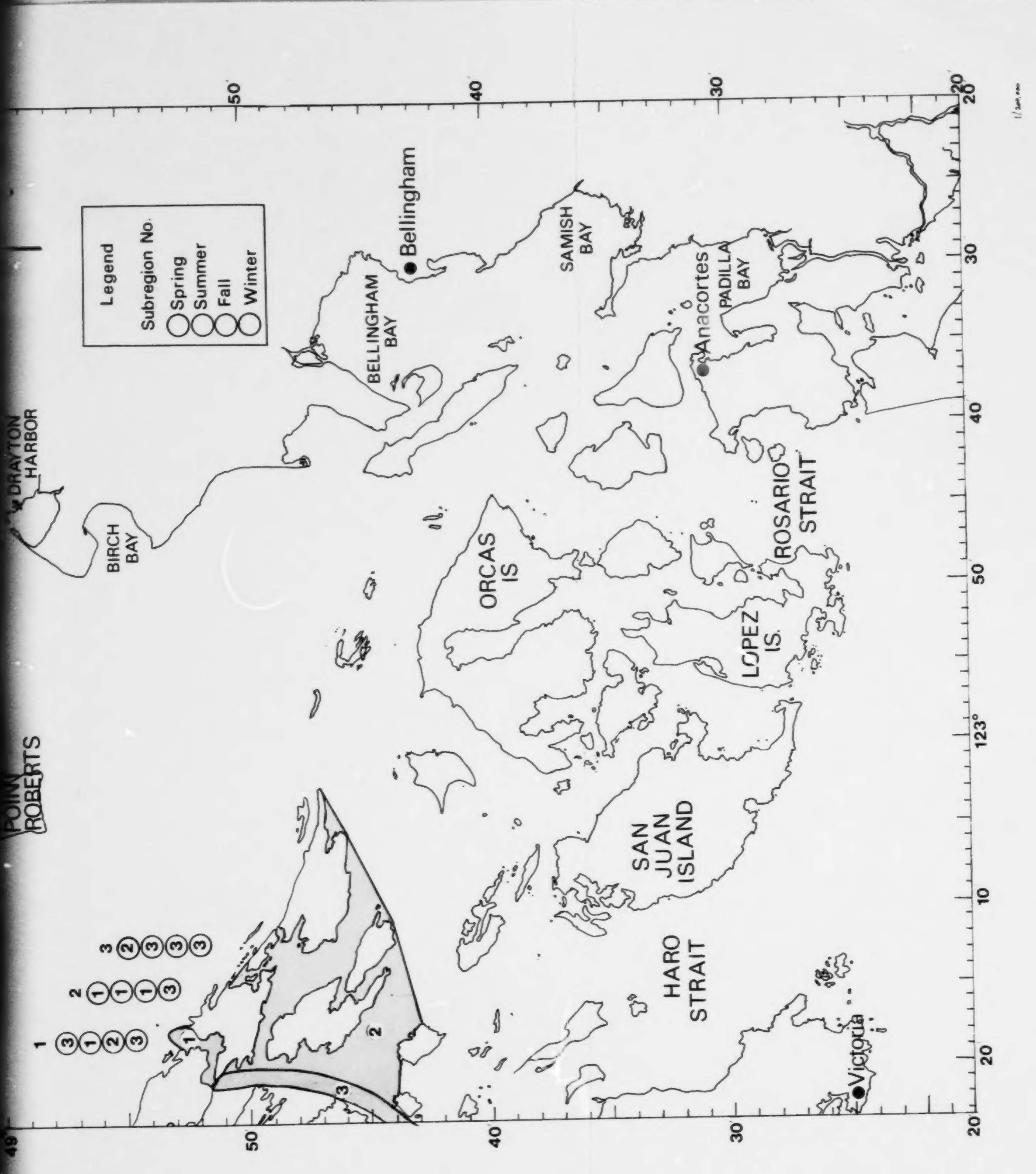


FIGURE 25. OVER-ALL SEASONAL RANKINGS FOR REGION 13.

B

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VI. LITERATURE CITED

Alcorn, G (1972): Bibliography. Birds of the State of Washington. Occ. Pap. Mus. Nat. Hist. No. 44, Univ. of Puget Sound, 538-630.

American Ornithologists' Union (1957): Checklist of North American Birds. Fifth ed. A.O.U., Baltimore.

________________________ (1973): Thirty-second supplement to the American Ornithologists' Union checklist of North American birds. *Auk.* 90:411-419.

________________________ (1976): Thirty-third supplement to the American Orthinologists' Union checklist of North American birds. *Auk.* 93:875-879.

Bakus, G. J. (1966): Avifauna of San Juan Island and Archipelago, Washington. Alan Hancock Foundation, University of Southern California, Los Angeles.

Binford, L., B. Elliott, and S. Singer (1975): Discovery of a nest and the downy young of the Marbled Murrelet. *Wilson Bull.* 87:303-319.

Briggs, K., E. Chu, P. Lewis, W. Tyler, R. Pitman, and G. Hunt, Jr. (1978): Distribution, numbers, and seasonal status of seabirds of the Southern California Bight. Appendix 2: Details of pelagic censusing methods. Pp. 257-276. In Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area. 1975-1978. Santa Cruz and Irvine, Regents of the Univ. of California.

Brittell, J. D., J. M. Brown, and R. L. Eaton (1976): Marine shoreline fauna of Washington. Vol. 2. Departments of Game and Ecology, Olympia.

Campbell, R. W., M. C. R. Edgell, M. F. Wainwright, and M. G. Shepard: MS. Winter distribution and numbers of waterbirds in Oak Bay, British Columbia.

Dawson, W. and J. Bowles (1909): The birds of Washington. The Occidental Publishing Co., Seattle.

Dixon, T. I. (1977): The distance at which setting birds can be seen at sea. *Ibis* 119:372-375.

Drent, R. (1965): Breeding biology of the Pigeon Guillemot, Cepphus columba. *Ardea* 53:99-160.

Drent, R., and C. Guiget (1961): A catalogue of British Columbia seabird colonies. Occ. Pap. B.C. Prov. Mus. 12, 173 pp.

Eaton, R. L. ed. (1975): Marine shoreline fauna of Washington: A status survey. Vol. 1. Departments of Game and Ecology, Olympia.

Galusha, J., and J. Stout (1977): Aggressive communication by Larus glaucescens. Part IV. Experiments on visual communication. *Behavior* 62(3-4):222-235.

Hartwick, B. (1973): Foraging strategy of the Black Oystercatcher. Unpubl. Ph.D. thesis, U.B.C., Vancouver, 138 pp.

Jewett, S., W. Taylor, W. Shaw, and J. Aldrich (1953): Birds of Washington State. Univ. of Washington Press, Seattle.

King, J. G., and G. H. Sanger. MS. An oil vulnerability index for marine oriented birds.

King, W. B. (1970): The trade wind zone oceanography pilot study. Part VII: Observations of seabirds March 1964 to June 1965. U.S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 586.

Kitchin, E. (1934): Distributional checklist of the birds of the state of Washington. *Northwest Fauna Series,* No. 1, 1-28.

Kury, C. and M. Gochfield (1975): Human interference and gull predation in cormorant colonies. *Biol. Conserv.* 8:23-34.

Leschner, L. (1976): The breeding biology of the Rhinoceros Auklet on Destruction Island. MS thesis, University of Washington, Seattle.

Lindstedt-Silva, J. (1978): Oil spill response planning for biologically sensitive areas in the northern Puget Sound region. Atlantic Richfield Co., Los Angeles.

Manuwal, D. A. (1978): Effect of man on marine birds: A review. Proc. John S. Wright Forestry Conf., Wildlife and People. Dept. of Forestry and Natural Resources, Purdue Univ.

Manuwal, D., and R. W. Campbell (In press): Status and distribution of breeding seabirds of southeastern Alaska, British Columbia, and Washington. U.S. Fish and Wildlife Service, Wildl. Report 11.

Mattocks, P. W., Jr., E. S. Hunn, and T. R. Wahl (1976): A checklist of the birds of Washington State, with recent changes annotated. *Western Birds* 7:1-24.

Nysewander, D. (1977): Reproductive success of the Black Oystercatcher in Washington State. MS thesis, Univ. of Washington, Seattle.

Palmer, R. (1962): Handbook of North American Birds. Vol. 1. Loons through Flamingos. Yale Univ. Press, New Haven.

Peters, C., K. Richter, D. Manuwal, S. Herman (1978): Colonial nesting sea and wading bird use of estuarine islands in the Pacific Northwest. Dredged Material Research Program, U.S. Army Corps of Engineers, Technical Report D-78-17.

Peterson, R. T. (1961): A field guide to western birds. 2nd ed. Houghton Mifflin Company, Boston.

Richardson, F. (1961): Breeding biology of the Rhinoceros Auklet on Protection Island, Washington. *Condor* 63:456-473.

Robbins, C. S., B. Brunn, H. S. Zim, and A. Singen (1966): A guide to field identification: Birds of North America. Golden Press, New York.

Robertson, I. (1974): Low seabird densities in the pelagic environment of the Strait of Georgia, British Columbia. *Pacific Science* 31(3):279-283.

Salo, L. J. (1975): A baseline survey of significant marine birds in Washington State. Departments of Game and Ecology, Olympia.

Soots, R., and J. Parnell (1975): Introduction to the nature of dredge islands and their wildlife in North Carolina and recommendations for management. Proc. Conf. on Manage. of Dredge Islands in North Carolina Estuaries 1-34.

Stout, J., and M. Brass (1969): Aggressive communication by *Larus glaucescens*. Part II. Visual Communication. *Behavior* 34(1-2):42-54.

Stout, J., C. Wilcox, and L. Creitz (1969): Aggressive communication by *Larus glaucescens*. Part I. Sound Communication. *Behavior* 34(1-2):29-41.

Summers, K., and R. Drent (1979): Breeding biology and twinning experiments of Rhinoceros Auklets in Cleland Island, British Columbia. *Murrelet* 60:16-22.

Thoresen, A., and E. Booth (1958): Breeding activities of the Pigeon Guillemot *Cepphus columba columba* (Pallas). Walla Walla Coll. Publ. Biol. Sci. 23, 36 pp.

Thoresen, A., and J. Galusha (1971): A nesting study of some islands in the Puget Sound Area. *Murrelet* 52:20-24.

Tuck, L. M. (1960): The Murres; their distribution, populations, and biology; a study of the genus *Uria*. Canadian Wildlife Series: I. Queen's Printer and Controller of Stationery, Ottawa.

Udvardy, M. D. F. (1963): Zoogeographical study of the Pacific Alcidae. Proc. 10th Pac. Sci. Congr. (1961) 85-111.

van Tets, G. F. (1959): A comparative study of the reproductive behavior and natural history of three sympatric species of cormorant (*Phalacrococax auritus*, *Ph. penicillatus*, *Ph. pelagicus*) at Mandarte Island, B.C. Unpubl. MA thesis, U.B.C., Vancouver.

van Tets, G. F. (1965): A comparative study of some social communication patterns in the Pelecaniformes. *A.O.U. Orinthol. Monogr.* 2, 88 pp.

Vermeer, K. (1963): The breeding ecology of the Glaucous-winged Gull (Larus glaucescens) on Mandarte Island, B.C. Occ. Pap. B.C. Prov. Mus. 13, 104 pp.

Vermeer, K. (1977): Some observations on Arctic Loons, Brandt's Cormorants and Bonaparte's Gulls at Active Pass, British Columbia. *Murrelet* 58:45-47.

Vermeer, K., and C. D. Levings (1977): Populations, biomass and food habits of ducks on the Frazer Delta intertidal area, British Columbia. *Wildfowl* 28:49-60.

Vermeer, K., and R. Vermeer (1974): Oil pollution of birds: An abstracted bibliography. Canadian Wildlife Service, Pesticide Section, Manuscript Report 29:1-68.

Vermeer, K., and R. Vermeer (1975): Oil threats to birds on the Canadian west coast. *Can. Field Nat.* 89:278-298.

Weins, J. A., D. Heinemann, and W. Hoffman (1978): Community structure, distribution, and interrelationships of marine birds in the Gulf of Alaska.

Wilson, U. (1977): A study of the biology of the Rhinoceros Auklet on Protection Island, Washington. MS thesis, Univ. of Washington, Seattle.

APPENDIX I

Regions and Subregions, Codes, and Areas.

Table 1. Breakdown of Regions and Subregions, their Codes and Areas (km^2) for Shoreline and Open Water Components.

		Region/ Subregion Code		Area (km^2)		
				Shoreline	Open Water	Total
Region	Swiftsure Bank	01--				
Subregion	Swiftsure Bank	0101			840.8	840.8
			Totals		840.8	840.8
Region	Strait of Juan de Fuca--Outer	02--				
Subregion	Strait of Juan de Fuca (outer)	0201			1,883.7	1,883.7
"	Vancouver Island	0202		51.5		51.5
"	Cape Flattery	0203		5.4		5.4
"	Neah Bay	0204		4.5		4.5
"	Neah Bay to Clallam Bay	0205		12.9		12.9
"	Clallam Bay	0206		3.2		3.2
"	Clallam Bay to Crescent Bay	0207		20.8		20.8
"	Crescent Bay	0208		1.1		1.1
"	Crescent Bay to Ediz Hook	0209		9.0		9.0
			Totals	108.4	1,883.7	1,992.1
Region	Strait of Juan de Fuca--Inner	03--				
Subregion	Strait of Juan de Fuca (inner)	0301			1,630.8	1,630.8
"	Ediz Hook	0302		0.4		0.4
"	Port Angeles	0303		10.4		10.4
"	Voice of America	0304		24.0		24.0
"	Dungeness Spit	0305		4.0		4.0
"	Dungeness Bay/Harbor	0306		12.0		12.0
"	Jamestown	0307		21.4		21.4
"	Sequim Bay	0308		11.8	2.0	13.8
"	Miller Peninsula	0309		4.8		4.8
"	Protection Island	0310		3.1		3.1
"	Discovery Bay	0311		13.0	24.1	37.1
"	Quimper Peninsula	0312		10.7		10.7

Table 1. (Continued)

		Region/ Subregion Code		Area (km^2) Shoreline	Open Water	Total
Subregion	Whidbey Island	0313		21.0		21.0
"	Smith Island	0314		0.3		0.3
"	Deception Pass	0315		5.6		5.6
"	Lopez Island (south shore)	0316		8.9		8.9
"	San Juan Island (south shore)	0317		3.5		3.5
"	Victoria, Vancouver Island	0318		6.9		6.9
			Totals	161.8	1,656.9	1,818.7
Region	Admiralty Inlet	04--				
Subregion	Admiralty Inlet	0401		15.5	25.4	40.9
			Totals	15.5	25.4	40.9
Region	Anacortes to Hale Passage	05--				
Subregion	Bellingham Channel	0501		4.7	69.2	73.9
"	Guemes Channel	0502		10.2		10.2
"	Fidalgo Bay	0503		11.5		11.5
"	Padilla Bay	0504		55.0	25.0	80.0
"	Samish Bay	0505		29.0	37.0	66.0
"	Bellingham Bay	0506		36.0	122.0	158.0
"	Hale Passage	0507		16.1		16.1
			Totals	162.5	253.2	415.7
Region	Georgia Strait--Eastern	06--				
Subregion	Lummi Bay	0601		17.0	8.0	25.0
"	Cherry Point	0602		14.1		14.1
"	Birch Bay	0603		9.0	10.0	19.0
"	Semiahmoo Spit	0604		9.5		9.5
"	Drayton Harbor	0605		12.8		12.8

Table 1. (Continued)

		Region/ Subregion Code		Area (km^2)		
				Shoreline	Open Water	Total
Subregion	Boundary Bay	0606		75.0	82.0	157.0
"	San Juan Islands--Northern Tier	0607		5.0	29.4	34.4
"	Georgia Strait	0608			288.3	288.3
			Totals	142.4	417.7	560.1
Region	Georgia Strait--Western	07--				
Subregion	Pt. Roberts	0701		16.3		16.3
"	Tsawwassen Bay	0702		6.1		6.1
"	Georgia Strait	0703			364.5	364.5
			Totals	22.4	364.5	386.9
Region	Haro Strait	08--				
Subregion	Northern Haro Strait	0801		9.6	329.1	338.7
"	Southern Haro Strait	0802		5.0	219.4	224.4
			Totals	14.6	548.5	563.1
Region	Rosario Strait	09--				
Subregion	Southern Rosario Strait	0901		10.8	112.4	123.2
"	Central Rosario Strait	0902		3.7	79.4	83.1
"	Northern Rosario Strait	0903		3.3	88.9	92.2
			Totals	17.8	280.7	298.5
Region	San Juan Islands--Northern Waters	10--				
Subregion	President Channel	1001		3.2	100.4	103.6
"	Northern Areas	1002		2.0	48.0	50.0
			Totals	5.2	148.4	153.6

Table 1. (Continued)

		Region/ Subregion Code		Area (km^2)		
				Shoreline	Open Water	Total
Region	San Juan Islands--Interior Channels and Passages	11--				
Subregion	Speiden Channel	1101		1.1	12.6	13.7
"	Northern San Juan Channel	1102		2.9	33.2	36.1
"	Southern San Juan Channel	1103		5.0	43.5	48.5
"	Wasp Pass	1104		2.5		2.5
"	Upright Channel	1105			8.8	8.8
"	Harney Channel	1106		2.2	30.7	32.9
"	Obstruction Pass	1107		2.5		2.5
"	Thatcher Pass	1108		0.9		0.9
			Totals	17.1	128.8	145.9
Region	San Juan Islands--Interior Bays	12--				
Subregion	Mosquito/Roche Complex	1201		10.2		10.2
"	Friday Harbor	1202		1.5		1.5
"	Griffin Bay	1203		12.0	7.5	19.5
"	Fisherman Bay	1205		1.9		1.9
"	Swifts/Shoal Bays	1206		4.6		4.6
"	Deer Harbor	1207		2.0		2.0
"	West Sound	1208		9.1		9.1
"	East Sound	1209		0.5	26.5	27.0
"	Lopez Sound	1210		23.9		23.9
			Totals	65.7	34.0	99.7

Table 1. (Continued)

		Region/ Subregion Code		Area (km^2)		
				Shoreline	Open Water	Total
Region	Canadian Waters	13--				
Subregion	Active Pass	1301		10.5		10.5
"	Canadian Gulf Islands	1302			142.9	142.9
"	Sidney Approach	1303			117.5	117.5
			Totals	10.5	260.4	270.9
			Grand Totals	743.9	6,843.0	7,586.9

APPENDIX II

Bird Oil Index Values and Methods of Derivation.

Derivation of Bird Oil Index Ratings

There are three components in the individual species Bird Oil Index (BOIs) value and each is equally weighted as given by

$$\text{BOIs} = \left(\frac{1}{2.5}\sum_{i=1}^{5} X_i\right)\left(\frac{1}{2.5}\sum_{i=1}^{5} Y_i\right)\left(\frac{1}{2.0}\sum_{i=1}^{4} Z_i\right) \qquad (1)$$

or

$$\text{BOIs} = X\cdot Y\cdot Z \qquad (2)$$

with respective components as above (1). The elements of the three components X, Y, Z are defined below.

X. Vulnerability of species as determined by habits of individual birds.

X_1. Roosting, night
score 5: Nearly always roosts on water
" 3: Spends moderate time roosting on water
" 1: Spends minimal time roosting on water
" 0: Never roosts on water

X_2. Escape behavior
score 5: Dives from danger
" 3: Swim from danger
" 1: Flies from danger

X_3. Flocking on water
score 5: Forms large flocks
" 3: Variable
" 1: Forms small flocks
" 0: Does not flock (in water)

X_4. Nesting concentration
score 5: Forms large colonies
" 3: Forms small colonies
" 1: Nests solitary

X_5. Feeding (foraging) specialization
score 5: Highly specialized (narrow)
" 3: Moderately adaptable
" 1: Generalist

Y. Vulnerability of species as determined by total population characteristics.

Y_1. Population size
score 5: Small population, limited numbers
" 3: Population of medium numbers
" 1: A large population

Y_2. Reproductive potential
score 5: Low reproductive capacity
" 3: Moderate reproductive capacity
" 1: Highly prolific

Y_3. Breeding distribution
score 5: Localized
" 3: Moderately widespread
" 1: Widespread

Y_4. Winter distribution
score 5: Concentrated
" 3: Moderately scattered (concentrated)
" 1: Widely scattered.

Y_5. Seasonal exposure in marine habitats
score 5: All year
" 3:
" 1: Minimal time on marine waters

Z. Significance of our area to whole population.

Z_1 = Spring
Z_2 = Summer
Z_3 = Fall
Z_4 = Winter

score 5: Large proportion of population utilizes area
" 3: Moderate " " " " "
" 1: Relatively small proportion of population utilizes area
" 0: Area not utilized.

Table 1. Bird Oil Index Values for Species Occurring and Potentially Occurring in the Study Area, Marine Waters of the State of Washington

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
	$X_1X_2X_3X_4X_5$	$\Sigma X_i/2.5$	$Y_1Y_2Y_3Y_4Y_5$	$\Sigma Y_i/2.5$	$Z_1Z_2Z_3Z_4$	$\Sigma Z_i/2.0$	
LOONS							
Common Loon	55115	6.8	15123	4.4	3133	5.0	149.6
Yellow-billed Loon	55115	6.8	55353	8.4	0001	0.5	28.6
Arctic Loon	55415	8.0	35123	5.6	3033	4.5	201.6
Red-throated Loon	55315	7.6	15335	6.8	3033	4.5	232.6
Large Loon[1]	55115	6.8	15223	5.2	3133	5.0	176.8
Small Loon[2]	55315	7.6	25234	6.4	3033	4.5	218.9
Loon (species)	55115	6.8	15223	5.2	3133	5.0	176.8
GREBES							
Red-necked Grebe	55215	7.2	13143	4.8	3033	4.5	155.5
Horned Grebe	55315	7.6	13143	4.8	3033	4.5	164.2
Eared Grebe	55315	7.6	13122	3.6	0001	0.5	13.7
Western Grebe	55515	8.4	13335	6.0	3135	6.0	302.4
Pied-billed Grebe	55115	6.8	13111	2.8	0001	0.5	9.5
Large Grebe[3]	55315	7.6	13334	5.6	3135	6.0	255.4
Small Grebe[4]	55315	7.6	13143	4.8	3033	4.5	164.2
Grebe (species)	55315	7.6	13133	4.4	3133	5.0	167.2
ALBATROSS							
Black-footed Albatross	53154	7.2	35515	7.6	111	2.0	109.4
Albatross (species)	53154	7.2	35515	7.6	111	2.0	109.4

Table 1. (Continued)

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
SHEARWATERS							
Northern Fulmar	53353	7.6	15115	5.2	1111	2.0	79.0
Pink-footed Shearwater	53353	7.6	15315	6.0	1110	1.5	68.4
Buller's Shearwater	53353	7.6	35545	8.8	0010	0.5	33.4
Sooty Shearwater	53553	8.4	15115	5.2	1110	1.5	65.5
Short-tailed Shearwater	53553	8.4	15115	5.2	1110	1.5	65.5
Dark Shearwater[5]	53553	8.4	15115	5.2	1110	1.5	65.5
Light-bellied Shearwater[6]	53353	7.6	15315	6.0	1110	1.5	68.4
Shearwater (species)	53553	8.4	15115	5.2	1110	1.5	65.5
STORM-PETRELS							
Fork-tailed Storm-Petrel	53355	8.4	15335	6.8	1110	1.5	85.7
Leach's Storm-Petrel	53355	8.4	15115	5.2	0100	0.5	21.8
Storm-Petrel (species)	53355	8.4	15335	6.8	1110	1.5	85.7
PELICANS							
White Pelican	53253	7.2	34532	6.8	0010	0.5	24.5
Brown Pelican	53253	7.2	34435	7.6	0010	0.5	27.4
CORMORANTS							
Double-crested Cormorant	13242	4.8	33123	4.8	3333	6.0	138.2
Brandt's Cormorant	13453	6.4	43445	8.0	1034	4.0	204.8
Pelagic Cormorant	13343	5.6	33335	6.8	3333	6.0	228.5
Cormorant sp.	13343	5.6	33335	6.8	3333	6.0	228.5
Large Cormorant	13343	5.6	33334	6.4	3333	6.0	215.0
Small Cormorant	13343	5.6	33335	6.8	3333	6.0	228.5

Table 1. (Continued)

Species	Vulnerability of Species as Determined by habits of individual		Vulnerability of Species as Determined by total population characteristics		Significance of Our Area to the Total Species Populations		B.O.I.*
HERONS							
Great Blue Heron	11131	2.8	33111	3.6	3331	5.0	50.4
Green Heron	11113	2.8	23111	3.2	2220	3.0	26.9
Common Egret	11132	3.2	13111	2.8	0011	1.0	9.0
American Bittern	11113	2.8	23111	3.2	1001	1.0	9.0
DUCKS AND GEESE							
Whistling Swan	51413	5.6	33343	6.4	1013	2.5	89.6
Trumpeter Swan	51413	5.6	53541	7.2	1011	1.5	60.5
Swan sp.	51413	5.6	33343	6.4	1011	1.5	53.8
Canada Goose	31311	8.6	33111	3.6	1111	2.0	25.9
Cackling Goose	31313	4.4	33111	3.6	1111	2.0	31.7
American Brant	53433	7.2	33335	6.8	0010	0.5	24.5
Black Brant	53433	7.2	43335	7.2	5044	6.5	337.0
Emperor Goose	33333	6.0	33355	7.6	0001	0.5	22.8
White-fronted Goose	11311	2.8	33331	5.2	2020	2.0	29.1
Small Goose	33331	5.2	33331	5.2	5044	6.5	175.8
Goose sp.	33331	5.2	33335	6.8	3033	4.5	159.1
Snow Goose	11441	4.4	33411	4.8	3035	5.5	116.2
Mallard	33311	4.4	31111	2.8	1112	2.5	30.8
Gadwall	33311	4.4	31311	3.6	1011	1.5	23.8
Common Pintail	33411	4.8	31111	2.8	3033	4.5	60.5
Green-winged Teal	33311	4.4	31111	2.8	1013	2.5	30.8
Blue-winged Teal	33211	4.0	31111	2.8	0110	1.0	11.2
Cinnamon Teal	33211	4.0	31111	2.8	0110	1.0	11.2
European Wigeon	33211	4.0	31511	4.4	1013	2.5	44.0
American Wigeon	33411	4.8	31111	2.8	3033	4.5	60.5
Northern Shoveler	33311	4.4	31111	2.8	3033	4.5	55.4
Dabbling Duck	33311	4.4	31111	2.8	3033	4.5	55.4
Teal sp.	33311	4.4	31111	2.8	1013	2.5	30.8

Table 1. (Continued)

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
Redhead	33313	5.2	53111	4.4	1011	1.5	34.3
Ring-necked Duck	33313	5.2	33111	3.6	0001	0.5	9.4
Canvasback	35413	6.4	53113	5.2	1012	2.0	66.6
Greater Scaup	35413	6.4	13115	4.4	3134	5.5	154.9
Lesser Scaup	35413	6.4	13113	3.6	1011	1.5	34.6
Scaup sp.	35413	6.4	13115	4.4	3134	5.5	154.9
Anatinine Ducks	35413	6.4	13111	2.8	3134	5.5	98.6
Common Goldeneye	55313	6.8	13113	3.6	3033	4.5	110.2
Barrow's Goldeneye	55413	7.2	13313	4.4	3035	5.5	174.2
Goldeneye sp.	55313	6.8	13113	3.6	3033	4.5	110.2
Bufflehead	55313	6.8	13113	3.6	3033	4.5	110.2
Oldsquaw	55313	6.8	13115	4.4	3033	4.5	134.6
Harlequin Duck	13313	4.4	13335	6.0	3434	7.0	184.8
King Eider	55513	7.6	13335	6.0	0001	0.5	22.8
White-winged Scoter	55513	7.6	13314	4.8	3234	6.0	218.9
Surf Scoter	55513	7.6	13315	5.2	4234	6.5	256.9
Black Scoter	55513	7.6	13315	5.2	3034	5.0	197.6
Scoter sp.	55513	7.6	133.5	5.2	3234	6.0	237.1
Dark Diving Duck	55513	7.6	13315	5.2	3233	5.5	217.4
Ruddy Duck	55513	7.6	11113	2.8	1013	2.5	53.2
Diving Duck	55413	7.2	13315	5.2	3134	5.5	205.9
Common Merganser	35413	6.4	13113	3.6	3034	5.0	115.2
Red-breasted Merganser	35313	6.0	13115	4.4	3034	5.0	132.0
Hooded Merganser	33113	4.4	33111	3.6	3034	5.0	79.2
Merganser sp.	35313	6.0	13115	4.4	3034	5.0	132.0
Duck sp.	33313	5.2	13113	3.6	3033	4.5	84.2
EAGLES AND HAWKS							
Golden Eagle	01011	1.2	55111	5.2	0001	0.5	3.1
Bald Eagle	01012	1.6	55121	5.6	4444	8.0	71.7

Table 1. (Continued)

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
Eagle sp.	01012	1.6	55121	5.6	4444	8.0	71.7
Osprey	01014	2.4	55111	5.2	1110	1.5	18.7
Peregrine Falcon	01013	2.0	55111	5.2	4045	6.5	67.6
Merlin	01013	2.0	55111	5.2	3034	5.0	52.0
Falcon sp.	01013	2.0	55111	5.2	3034	5.0	52.0
RAILS							
American Coot	31211	3.2	1111	2.0	3033	4.5	28.8
OYSTER CATCHERS							
Black Oysterchatcher	11125	4.0	35555	9.2	3333	6.0	220.8
PLOVERS							
Charadriidae	11113	2.8	33123	4.8	2132	4.0	53.8
Semipalmated Plover	11112	2.4	13111	2.8	3030	3.0	20.2
Snowy Plover	11113	2.8	43133	5.6	0010	0.5	7.8
Killdeer	11111	2.0	13111	2.8	3332	5.5	30.8
American Golder Plover	11113	2.8	33113	4.4	1010	1.0	12.3
Black-bellied Plover	11113	2.8	33115	5.2	3031	3.5	51.0
Pluvialis sp.	11113	2.8	33115	5.2	3031	3.5	51.0
Plover sp.	11113	2.8	33113	4.4	3031	3.5	43.1
SANDPIPERS AND OTHER SHOREBIRDS							
Scolopacidae sp.	11112	2.4	33213	4.8	3032	4.0	46.1
Ruddy Turnstone	11113	2.8	33135	6.0	2020	2.0	33.6
Black Turnstone	11113	2.8	33535	7.6	4043	5.5	117.0
Turnstone sp.	11113	2.8	33535	7.6	4043	5.5	117.0
Common Snipe	11111	2.0	13111	2.8	1011	1.5	8.4
Long-billed Curlew	11112	2.4	33311	4.4	1010	1.0	10.6
Whimbrel	11113	2.8	33113	4.4	3130	3.5	43.1

Table 1. (Continued)

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
Curlew sp.	11113	2.8	33313	5.2	3130	3.5	51.0
Spotted Sandpiper	11111	2.0	13111	2.8	1110	1.5	8.4
Wandering Tattler	11113	2.8	53515	7.6	1020	1.5	31.9
Willet	11112	2.4	33313	5.2	1110	1.5	18.7
Greater Yellowlegs	11111	2.0	33111	3.6	3030	3.0	21.6
Lesser Yellowlegs	11111	2.0	33111	3.6	3030	3.0	21.6
Yellowlegs sp.	11111	2.0	33111	3.6	3030	3.0	21.6
Red Knot	11112	2.4	33115	5.2	0010	0.5	6.2
Rock Sandpiper	11113	2.8	33535	7.6	0001	0.5	10.6
Sharp-tailed Sandpiper	11113	2.8	33335	6.8	0010	0.5	9.5
Pectoral Sandpiper	11113	2.8	33131	4.4	1030	2.0	24.6
Baird's Sandpiper	11112	2.4	33131	4.4	1030	2.0	21.1
Least Sandpiper	11112	2.4	13133	4.4	3131	4.0	42.2
Dunlin	11112	2.4	13115	4.4	3034	5.0	52.8
Semipalmated Sandpiper	11112	2.4	13113	3.6	0001	0.5	4.3
Western Sandpiper	11112	2.4	13535	6.8	3031	3.5	57.1
Buff-breasted Sandpiper	11113	2.8	53531	6.8	0010	0.5	9.5
Sanderling	11113	2.8	33315	6.0	2022	3.0	50.4
Calidris Sandpiper	11113	2.8	33313	5.2	3033	4.5	65.5
Peep	11112	2.4	13114	4.0	3031	3.5	33.6
Surfbird	11113	2.8	33555	8.4	3033	4.5	105.8
Short-billed Dowitcher	11113	2.8	33333	6.0	3030	3.0	50.4
Long-billed Dowitcher	11113	2.8	33533	6.8	3030	3.0	57.1
Dowitcher sp.	11113	2.8	33433	6.4	3030	3.0	53.8
Marbled Godwits	11113	2.8	33313	5.2	0010	0.5	7.3
Bar-tailed Godwits	11113	2.8	33315	6.0	0010	0.5	8.4
Hudsonian Godwits	11113	2.8	53311	5.2	0010	0.5	7.3
Godwit sp.	11113	2.8	33313	5.2	0010	0.5	7.3

Table 1. *(Continued)*

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
PHALAROPES							
Red Phalarope	51114	4.8	13315	5.2	0010	0.5	12.5
Wilson's Phalarope	51514	6.4	13315	5.2	0010	0.5	16.6
Northern Phalarope	51514	6.4	13315	5.2	1030	2.0	66.6
Phalarope	51514	6.4	13315	5.2	1030	2.0	66.6
JAEGERS							
Pomarine Jaeger	31213	4.0	13115	4.4	0010	0.5	8.8
Parasitic Jaeger	31213	4.0	13115	4.4	2020	1.0	17.6
Long-tailed Jaeger	31213	4.0	13113	3.6	0010	0.5	7.2
Jaeger sp.	31213	4.0	13115	4.4	2020	2.0	35.2
Large Jaeger	31213	4.0	13115	4.4	2020	2.0	35.2
Small Jaeger	31213	4.0	13113	3.6	2020	2.0	28.8
Skua	31113	3.6	13115	4.4	0010	0.5	7.9
GULLS AND TERNS							
Glaucous Gull	31331	4.4	13135	5.2	0001	0.5	11.4
Glaucous-winged Gull	31351	5.2	13235	5.6	3334	6.5	189.3
Western Gull	31351	5.2	23335	6.4	1111	2.0	66.6
Western Glaucous-w. Gull	31351	5.2	13335	6.0	3334	6.5	202.8
Herring Gull	31341	4.8	13113	3.6	1012	2.0	34.6
Herring x Glaucous-w. Gull	31351	5.2	13223	4.4	1012	2.0	45.8
Thayer's Gull	31351	5.2	33353	6.8	3034	5.0	176.8
Herring x Thayer's Gull	31351	5.2	23333	5.6	3034	5.0	145.6
California Gull	31351	5.2	13323	4.8	2041	3.5	87.4
Dark immature Gull	31351	5.2	13333	5.2	2032	3.5	94.6
Ring-billed Gull	31351	5.2	13123	4.0	1010	1.0	20.8
Mew Gull	31331	4.4	13123	4.0	3033	4.5	79.2
Dark Gull	31351	5.2	13233	4.8	3033	4.5	112.3
Franklin's Gull	31352	5.6	23313	4.8	0010	0.5	13.4

Table 1. *(Continued)*

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
Bonaparte's Gull	31512	4.8	13123	4.0	4141	5.0	96.0
Little Gull	31312	4.0	53553	8.4	0010	0.5	16.8
Heerman's Gull	31351	5.2	33525	7.2	0240	3.0	112.3
Black-legged Kittiwake	31353	6.0	13115	4.4	1011	1.5	39.6
Sabine's Gull	31333	5.2	13335	6.0	1010	1.0	31.2
Small Gull	31322	4.4	13335	6.0	3131	4.0	105.6
Common Tern	11343	4.8	13113	3.6	3030	3.0	51.8
Arctic Tern	11343	4.8	13115	4.4	1010	1.0	21.1
Small Tern	11343	4.8	13113	3.6	3030	3.0	51.8
Caspian Tern	11353	5.2	13313	4.4	0110	1.0	22.9
Tern sp.	11343	4.8	13113	3.6	3030	3.0	51.8
Laridae sp.	31341	4.8	13333	5.2	3333	6.0	149.8
Gull sp.	31341	4.8	13333	5.2	3333	6.0	149.8
ALCIDS							
Common Murre	55554	9.6	15125	5.6	3144	6.0	322.6
Thick-billed Murre	55554	9.6	15125	5.6	0010	0.5	26.9
Pigeon Guillemot	55334	8.0	23445	7.2	3333	6.0	345.6
Marbled Murrelet	55415	8.0	25445	8.0	4444	8.5	544.0
Ancient Murrelet	55455	9.6	13445	6.8	2024	4.0	261.1
Xantus Murrelet	55245	8.4	33545	8.0	0010	0.5	33.6
Cassin's Auklet	55555	10.0	15445	7.6	1110	1.5	114.0
Rhinoceros Auklet	55555	10.0	15435	7.2	4541	7.0	504.0
Horned Puffin	55355	9.2	15315	6.0	0010	0.5	27.6
Tufted Puffin	55355	9.2	15315	6.0	1110	1.5	82.8
Large Alcid	55355	9.2	15335	6.8	3331	5.0	312.8
Small Alcid	55555	10.0	15445	7.6	4444	8.0	608.0

Table 1. (Continued)

Species	Vulnerability of Species as Determined by				Significance of Our Area to the Total Species Populations		B.O.I.*
	habits of individual		total population characteristics				
Murrelet sp.	55454	9.2	25445	8.0	4444	8.0	588.8
Alcid sp.	55455	9.6	14335	6.4	3333	6.0	368.6

*Bird Oil Index (BOI). B.O.I. = $\left(\frac{\Sigma X_i}{2.5}\right)\left(\frac{\Sigma Y_i}{2.5}\right)\left(\frac{\Sigma Z_i}{2.0}\right)$

[1] Arctic/Red-throated Loon
[2] Common/Yellow-billed Loon
[3] Red-necked/Western Grebe
[4] Horned/Eared Grebe
[5] Sooty/Short-tailed Shearwater
[6] Pink-footed/Buller's Shearwater

APPENDIX III

Seasonal Occurrences of Bird Species Observed in the Study Area.

Table 1. *Regional Occurrences of Bird Species in Spring 1978*

Species	Region 1*	2	3	4	5	6	7	8	9	10	11	12	13
UNINDENTIFIED SPECIES													
Diving Bird		x	x		x	x	x	x	x	x	x		x
LOONS													
Common Loon		x	x	x	x	x	x	x	x		x	x	x
Yellow-billed Loon			x										
Arctic Loon		x	x	x	x	x	x	x	x	x	x	x	x
Red-throated Loon		x	x	x	x	x	x		x		x	x	x
Loon sp.		x	x		x	x	x	x	x	x	x		x
Small loon			x				x				x		
GREBES													
Red-necked Grebe		x	x	x	x	x	x	x	x	x	x	x	x
Horned Grebe		x	x	x	x	x	x	x	x	x	x	x	x
Eared Grebe			x				x					x	
Western Grebe		x	x	x	x	x	x	x	x	x	x	x	x
Pied-billed Grebe									x				
Grebe sp.		x	x	x	x	x	x	x	x	x	x		x
CORMORANTS													
Double-crested Cormorant		x	x	x	x	x	x	x	x		x	x	x
Brandt's Cormorant		x	x		x	x	x	x	x		x	x	x
Pelagic Cormorant		x	x	x	x	x	x	x	x	x	x	x	x
Cormorant sp.		x	x		x	x	x	x	x	x	x	x	x
HERONS													
Great Blue Heron		x	x		x	x	x	x		x	x	x	
DUCKS AND GEESE													
Swan sp.												x	
Canada Goose			x						x				

Table 1. (Continued)

Species	Region 1*	2	3	4	5	6	7	8	9	10	11	12	13
American Brant													
Black Brant		x	x	x	x	x	x	x	x		x		x
Mallard			x	x	x	x					x		
Gadwall						x							
Common Pintail			x		x	x							
Green-winged Teal		x	x		x	x						x	
European Wigeon			x										
American Wigeon			x		x	x							
Northern Shoveler			x		x	x							
Teal sp.						x							
Canvasback					x								
Greater Scaup		x	x		x	x	x				x	x	x
Scaup sp.		x	x		x	x	x		x			x	
Common Goldeneye		x	x		x	x	x	x	x	x	x	x	
Barrow's Goldeneye		x	x		x							x	
Goldeneye sp.		x	x		x	x	x	x				x	
Bufflehead		x	x	x	x	x	x	x	x	x	x	x	x
Oldsquaw		x	x	x	x	x	x	x	x		x	x	x
Harlequin Duck		x	x	x	x	x	x	x	x		x	x	x
White-winged Scoter		x	x	x	x	x	x	x	x	x	x	x	x
Surf Scoter		x	x	x	x	x	x	x	x	x	x	x	x
Black Scoter		x	x		x	x	x				x		
Scoter sp.		x	x		x	x	x	x	x	x	x	x	x
Ruddy Duck		x	x			x							
Common Merganser		x	x			x							x
Red-breasted Merganser		x	x	x	x	x	x	x	x	x	x	x	x
Hooded Merganser			x		x								
Duck sp.		x	x		x	x	x	x	x	x		x	

Table 1. (Continued)

	Region												
Species	1*	2	3	4	5	6	7	8	9	10	11	12	13
EAGLES AND HAWKS													
Bald Eagle		x	x		x	x		x	x	x	x	x	x
Eagle sp.		x											
Osprey			x						x				
RAILS													
American Coot		x	x		x	x							
OYSTERCATCHERS													
Black Oystercatcher		x	x		x	x			x		x		
PLOVERS													
Semipalmated Plover			x			x							
Killdeer		x	x	x	x	x	x						
Black-bellied Plover		x	x		x	x							
SANDPIPERS AND OTHER SHOREBIRDS													
Scolopacidae sp.			x		x	x		x					
Ruddy Turnstone		x	x										
Black Turnstone		x	x		x	x	x		x		x		
Whimbrel		x	x		x	x							
Spotted Sandpiper		x	x		x	x							
Wandering Tattler		x	x										
Greater Yellowlegs		x	x		x	x							
Rock Sandpiper		x	x						x				
Least Sandpiper			x										
Dunlin		x	x		x	x							
Western Sandpiper		x	x		x	x	x						
Sanderling		x	x			x	x						
Peep			x		x	x					x		
Surfbird						x							

Table 1. (Continued)

Species	Region 1*	2	3	4	5	6	7	8	9	10	11	12	13
Short-billed Dowitcher		x	x		x								
Dowitcher sp.			x			x							
PHALAROPES													
Northern Phalarope		x							x				
Phalarope sp.		x											
GULLS AND TERNS													
Glaucous Gull						x							
Glaucous-winged Gull		x	x	x	x	x	x	x	x	x	x	x	x
Western Gull		x	x										
WesternXGlaucous-winged Gull							x						
Herring Gull		x	x			x	x	x	x	x			x
Thayer's Gull		x			x	x	x						x
California Gull			x		x	x	x						
Dark immature gull													x
Ring-billed Gull			x		x	x							
Mew Gull		x	x	x	x	x	x	x	x	x	x	x	x
Dark gull (dk primaries)						x							
Bonaparte's Gull		x	x	x	x	x	x	x	x	x	x		x
Heermann's Gull		x											
Black-legged Kittiwake		x											
Small gull											x		
Common Tern						x							
Caspian Tern		x											
Gull sp.		x	x	x	x	x	x	x	x	x	x	x	x
ALCIDS													
Common Murre		x	x	x	x	x	x	x	x	x	x	x	x
Pigeon Guillemot		x	x	x	x	x	x	x	x	x	x	x	x
Marbled Murrelet		x	x	x	x	x	x	x	x	x	x	x	x

Table 1. (Continued)

Species	Region 1*	2	3	4	5	6	7	8	9	10	11	12	13
Cassin's Auklet			x				x						
Rhinoceros Auklet		x	x	x	x	x		x	x		x	x	x
Tufted Puffin		x	x	x									
Alcid sp.		x	x		x				x		x		x

Note: *Not censused during period.

Table 2. Regional Occurrences of Bird Species in Summer 1978

	Region												
Species	1	2	3	4	5	6	7	8	9	10	11	12	13
UNINDENTIFIED SPECIES													
Diving Bird	x	x	x		x	x		x	x	x			x
LOONS													
Common Loon		x	x		x	x		x	x				
Arctic Loon		x	x		x				x				
Red-throated Loon			x		x								
Loon sp.			x		x	x							
GREBES													
Red-necked Grebe					x	x							
Horned Grebe						x							
Western Grebe			x		x	x	x	x					
Grebe sp.					x		x						
SHEARWATERS													
Northern Fulmar	x												
Pink-footed Shearwater	x												
Sooty Shearwater	x		x										
STORM-PETRELS													
Fork-tailed Storm-Petrel	x		x										
CORMORANTS													
Double-crested Cormorant		x	x		x	x	x	x	x	x	x	x	x
Brandt's Cormorant		x	x		x						x		
Pelagic Cormorant		x	x	x	x	x	x	x	x	x	x	x	x
Cormorant sp.		x	x		x	x	x	x	x	x	x	x	x
HERONS													
Great Blue Heron		x	x		x	x	x		x		x	x	x

Table 2. (Continued)

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
DUCKS AND GEESE													
Canada Goose			x										
Black Brant			x										
Small goose						x							
Snow Goose			x										
Mallard			x		x	x							
Common Pintail			x		x	x							
American Wigeon			x										
Scaup sp.		x	x		x	x							
Common Goldeneye						x							
Barrow's Goldeneye						x							
Goldeneye sp.					x	x							
Bufflehead			x			x							
Oldsquaw			x		x	x							
Harlequin Duck			x		x	x	x	x	x				x
White-winged Scoter		x	x	x	x	x	x			x			x
Surf Scoter		x	x		x	x	x	x	x		x		x
Black Scoter			x										
Scoter sp.		x	x		x	x		x	x				
Ruddy Duck						x							
Red-breasted Merganser			x		x	x							
Merganser sp.					x								
Duck sp.			x		x	x		x		x			
EAGLES AND HAWKS													
Bald Eagle		x			x	x		x	x		x		x
RAILS													
American Coot						x							

Table 2. (Continued)

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
OYSTERCATCHERS													
Black Oystercatcher		x	x										x
PLOVERS													
Semipalmated Plover			x		x	x							
Killdeer		x	x		x	x	x						
Black-bellied Plover			x		x	x							
Plover sp.			x										
SANDPIPERS AND OTHER SHOREBIRDS													
Scolopacidae sp.	x		x										
Ruddy Turnstone			x										
Whimbrel		x	x			x							
Spotted Sandpiper			x		x	x							
Wandering Tattler			x										
Greater Yellowlegs			x		x	x							
Least Sandpiper		x			x	x							
Dunlin			x										
Western Sandpiper		x	x		x	x							
Sanderling			x										
Peep			x		x	x							
Short-billed Dowitcher			x										
Dowitcher sp.			x	x	x								
GULLS AND TERNS													
Glaucous-winged Gull	x	x	x	x	x	x	x	x	x	x	x	x	x
Western Gull	x	x	x				x						
WesternXGlaucous-winged Gull			x	x			x						x
Herring Gull		x	x	x			x						
Thayer's Gull			x										
California Gull	x	x	x		x	x	x		x		x		

Table 2. (Continued)

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
Ring-billed Gull			x	x	x	x							
Mew Gull		x	x		x	x			x		x		
Bonaparte's Gull			x		x	x		x	x	x	x		
Heermann's Gull		x	x	x		x					x	x	
Common Tern						x							
Caspian Tern			x			x							
Gull sp.	x	x	x		x	x	x	x	x	x		x	
ALCIDS													
Common Murre	x	x	x	x	x	x	x		x		x		
Pigeon Guillemot		x	x	x	x	x	x	x	x	x	x	x	x
Marbled Murrelet			x	x	x	x	x	x	x	x	x		x
Cassin's Auklet	x												x
Rhinoceros Auklet	x	x	x	x	x		x	x	x	x	x	x	x
Tufted Puffin	x	x	x										
Large alcid			x										
Alcid sp.			x						x				

Table 3. Regional Occurrences of Bird Species in Fall 1978

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
UNINDENTIFIED SPECIES													
Diving Bird	x	x	x	x	x	x	x	x	x	x	x	x	x
LOONS													
Common Loon	x	x	x	x	x	x	x	x	x	x	x	x	x
Arctic Loon	x	x	x	x	x	x	x	x	x	x	x	x	x
Red-throated Loon	x	x	x		x	x	x	x	x		x	x	x
Loon sp.		x	x	x	x	x	x	x	x		x	x	x
Small loon			x										
GREBES													
Red-necked Grebe	x	x	x	x	x	x	x	x	x		x	x	x
Horned Grebe	x	x	x	x	x	x	x	x	x	x	x	x	x
Eared Grebe			x		x	x							
Western Grebe	x	x	x	x	x	x	x	x	x	x	x	x	x
Pied-billed Grebe			x			x							
Small grebe			x		x	x	x	x	x	x			
Grebe sp.		x	x		x	x	x	x	x				
ALBATROSSES													
Black-footed Albatross	x												
SHEARWATERS													
Northern Fulmar	x		x										
Pink-footed Shearwater	x												
Buller's Shearwater	x												
Sooty Shearwater	x	x	x								?Sept.		
Shearwater sp.	x												
Fork-tailed Storm-Petrel	x	x	x						?		?		

Table 3. (Continued)

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
CORMORANTS													
Double-crested Cormorant		x	x	x	x	x	x	x	x	x	x	x	x
Brandt's Cormorant		x	x		x	x	x	x	x		x	x	x
Pelagic Cormorant	x	x	x	x	x	x	x	x	x	x	x	x	x
Cormorant sp.	x	x	x	x	x	x	x	x	x	x	x	x	x
Large cormorant		x	x										
HERONS													
Great Blue Heron	x	x	x	x	x	x	x	x	x	x	x	x	x
DUCKS AND GEESE													
Canada Goose			x			x							
Black Brant			x										
White-fronted Goose			x										
Snow Goose			x										
Mallard	x		x		x	x			x				
Common Pintail		x	x	x	x	x						x	
Green-winged Teal		x	x		x	x							
European Wigeon			x		x	x							
American Wigeon	x	x	x	x	x	x							x
Northern Shoveler			x		x								
Dabbling duck					x	x	x						
Teal sp.						x							
Canvasback					x	x							
Greater Scaup		x	x		x							x	x
Scaup sp.		x	x		x	x	x						
Common Goldeneye			x		x								
Barrow's Goldeneye			x			x							
Goldeneye sp.					x								
Bufflehead		x	x		x	x						x	x
Oldsquaw		x	x			x	x					x	x

Table 3. (Continued)

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
Harlequin Duck		x	x	x	x	x	x	x	x	x	x	x	x
White-winged Scoter	x	x	x	x	x	x	x	x	x	x	x	x	x
Surf Scoter	x	x	x	x	x	x	x	x	x	x	x	x	x
Black Scoter		x	x		x	x	x						x
Scoter sp.		x	x	x	x	x	x	x	x		x	x	x
Ruddy Duck					x	x							
Diving duck					x	x							
Common Merganser			x		x	x	x		x		x	x	x
Red-breasted Merganser		x	x		x	x	x	x	x	x	x	x	x
Hooded Merganser			x		x							x	
Merganser sp.		x	x		x	x			x		x	x	x
Duck sp.	x	x	x	x	x	x	x	x	x	x	x	x	x
EAGLES AND HAWKS													
Bald Eagle		x	x		x	x		x	x	x	x	x	x
Eagle sp.									x				
Osprey					x	x							
Peregrine Falcon			x										
RAILS													
American Coot		x	x		x	x							
OYSTERCATCHERS													
Black Oystercatcher		x	x		x			x	x		x	x	x
PLOVERS													
Semipalmated Plover		x	x		x	x							
Killdeer		x	x	x	x	x	x		x				
Black-bellied Plover			x		x	x							

Table 3. (Continued)

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
SANDPIPERS AND OTHER SHOREBIRDS													
Scolopacidae sp.		x	x			x			x			x	
Ruddy Turnstone			x		x								
Black Turnstone		x	x		x	x			x				
Common Snipe		x	x										
Whimbrel			x										
Spotted Sandpiper		x	x		x	x		x					
Wandering Tattler			x										
Greater Yellowlegs			x		x	x						x	
Lesser Yellowlegs		x	x		x	x							
Yellowlegs sp.						x							
Red Knot			x										
Pectoral Sandpiper		x											
Baird's Sandpiper			x		x	x							
Least Sandpiper		x	x		x	x							
Dunlin		x	x		x	x							
Western Sandpiper		x	x		x	x							
Sanderling		x	x	x	x	x	x						
Peep		x	x		x	x						x	x
Surfbird			x		x			x	x	x			
Short-billed Dowitcher			x										
Long-billed Dowitcher			x										
Dowitcher sp.			x		x	x							
Marbled Godwit			x										
PHALAROPES													
Red Phalarope			x										
Northern Phalarope		x	x						x		x		x
Phalarope sp.	x	x	x	x					x				

Table 3. (Continued)

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
JAEGERS													
Pomarine Jaeger	x												
Parasitic Jaeger			x		x	x	x		x	x	x	x	x
Jaeger sp.						x							
GULLS AND TERNS													
Glaucous-winged Gull	x	x	x	x	x	x	x	x	x	x	x	x	x
Western Gull	x	x	x			x	x	x					x
WesternXGlaucous-winged Gull		x	x			x	x						x
Herring Gull	x	x	x	x		x	x	x	x	x	x		
Thayer's Gull			x	x		x	x	x			x	x	x
California Gull	x	x	x	x	x	x	x	x	x	x	x	x	x
Dark immature gull			x										
Ring-billed Gull		x	x		x	x	x						
Mew Gull	x	x	x	x	x	x	x	x	x	x	x	x	x
Dark gull (dk primaries)			x		x								
Franklin's Gull					x								
Bonaparte's Gull	x	x	x	x	x	x	x	x	x	x	x	x	x
Heermann's Gull	x	x	x	x	x	x	x	x	x	x	x	x	x
Sabine's Gull	x	x											
Small gull					x	x							
Common Tern	x	x	x	x	x	x	x	x	x	x	x	x	x
Arctic Tern	x										x		
Small tern		x	x			x	x						
Caspian Tern			x		x	x							
Tern sp.			x		x				x	x			
Gull sp.	x	x	x	x	x	x	x	x	x	x	x	x	x
ALCIDS													
Common Murre	x	x	x	x	x	x	x	x	x	x	x		x
Pigeon Guillemot	x	x	x	x	x	x	x	x	x	x	x	x	x

Table 3. *(Continued)*

Species	Region 1	2	3	4	5	6	7	8	9	10	11	12	13
Ancient Murrelet	x		x										x
Cassin's Auklet	x		x										
Rhinoceros Auklet	x	x	x	x	x	x		x	x		x	x	x
Tufted Puffin	x	x	x	x									
Small alcid	x												
Murrelet sp.	x												
Alcid sp.	x	x	x		x		x				x		

Table 4. Regional Occurrences of Bird Species in Winter 1978

Species	Region 1*	2	3	4	5	6	7	8	9	10	11	12	13
UNINDENTIFIED SPECIES													
Diving Bird		x	x		x	x	x	x	x	x	x		
LOONS													
Common Loon		x	x	x	x	x	x	x	x	x	x	x	x
Yellow-billed Loon			x		x			x					
Arctic Loon		x	x	x	x	x	x	x	x	x	x	x	x
Red-throated Loon		x	x	x	x	x	x	x	x	x	x	x	x
Loon sp.		x	x	x	x	x	x	x	x	x	x	x	x
Small loon		x	x						x		x		
GREBES													
Red-necked Grebe		x	x	x	x	x	x	x	x	x	x	x	x
Horned Grebe		x	x	x	x	x	x	x	x	x	x	x	x
Eared Grebe		x	x		x	x	x				x	x	
Western Grebe		x	x	x	x	x	x	x	x	x	x	x	x
Pied-billed Grebe			x		x	x					x		
Small grebe			x										
Grebe sp.		x	x		x	x		x	x	x	x		
STORM-PETRELS													
Fork-tailed Storm-Petrel		x											
CORMORANTS													
Double-crested Cormorant		x	x	x	x	x	x	x	x	x	x	x	x
Brandt's Cormorant		x	x	x	x	x	x	x	x	x	x	x	x
Pelagic Cormorant		x	x	x	x	x	x	x	x	x	x	x	x
Cormorant sp.		x	x	x	x	x	x	x	x	x	x	x	x
Large cormorant		x											

Table 4. *(Continued)*

Species	Region												
	1*	2	3	4	5	6	7	8	9	10	11	12	13
HERONS													
Great Blue Heron		x	x	x	x	x	x	x	x	x	x	x	x
DUCKS AND GEESE													
Whistling Swan					x								
Swan sp.					x								
Canada Goose			x		x	x						x	
American Brant			x										
Black Brant		x	x	x	x	x		x	x	x		x	x
Goose sp.						x							
Mallard		x	x		x	x							
Common Pintail		x	x		x	x				x		x	
Green-winged Teal		x	x		x	x							
Blue-winged Teal			x										
European Wigeon			x		x	x							
American Wigeon		x	x		x	x	x				x	x	x
Northern Shoveler			x		x								
Dabbling duck			x		x	x							
Canvasback			x		x	x	x					x	
Greater Scaup		x	x		x	x	x		x		x	x	
Lesser Scaup		x	x										
Scaup sp.		x	x	x	x	x	x	x	x	x	x	x	x
Common Goldeneye		x	x	x	x	x	x	x	x	x	x	x	x
Barrow's Goldeneye			x		x	x	x		x			x	x
Goldeneye sp.		x	x			x			x		x		
Bufflehead		x	x	x	x	x	x	x	x	x	x	x	x
Oldsquaw		x	x	x	x	x	x	x	x	x	x	x	x
Harlequin Duck		x	x	x	x	x	x	x	x	x	x	x	x
King Eider													
White-winged Scoter		x	x	x	x	x	x	x	x	x	x	x	x

Table 4. (Continued)

Species	Region												
	1*	2	3	4	5	6	7	8	9	10	11	12	13
Surf Scoter		x	x	x	x	x	x	x	x	x	x	x	x
Black Scoter		x	x		x	x	x		x	x	x	x	x
Scoter sp.		x	x	x	x	x	x	x	x	x	x	x	x
Dark diving duck					x								
Ruddy Duck			x		x	x						x	
Diving duck		x	x	x	x	x	x	x	x	x	x		x
Common Merganser			x		x	x		x		x	x		x
Red-breasted Merganser		x	x	x	x	x	x	x	x	x	x	x	x
Hooded Merganser		x	x		x	x					x	x	x
Merganser sp.			x		x	x	x	x	x	x	x	x	x
Duck sp.		x	x	x	x	x	x	x	x	x	x	x	x
EAGLES AND HAWKS													
Golden Eagle											x		
Bald Eagle		x	x		x	x		x	x	x	x	x	x
Eagle sp.			x						x				
Osprey						x							
RAILS													
American Coot		x	x		x	x							
OYSTERCATCHERS													
Black Oystercatcher		x	x		x	x			x	x	x	x	x
PLOVERS													
Killdeer		x	x		x	x			x	x		x	
Black-bellied Plover			x		x	x			x				x
SANDPIPERS AND OTHER SHOREBIRDS													
Scolopacidae sp.		x	x		x		x						
Ruddy Turnstone			x			x							

Table 4. (Continued)

Species	Region 1*	2	3	4	5	6	7	8	9	10	11	12	13
Black Turnstone		x	x		x	x			x	x	x	x	x
Common Snipe			x										
Whimbrel			x										
Spotted Sandpiper			x		x	x			x				
Greater Yellowlegs						x						x	
Rock Sandpiper		x	x						x				
Least Sandpiper			x		x								
Dunlin		x	x		x	x	x		x		x		x
Western Sandpiper			x										
Sanderling		x	x		x		x			x			
Peep			x			x							
Surfbird		x	x		x			x	x				x
Long-billed Dowitcher			x										
Dowitcher sp.			x										
PHALAROPES													
Red Phalarope		x	x										
Northern Phalarope		x											
JAEGERS													
Parasitic Jaeger					x								
GULLS AND TERNS													
Glaucous-winged Gull		x	x	x	x	x	x	x	x	x	x	x	x
Western Gull		x	x								x		
WesternXGlaucous-winged Gull		x	x							x			x
Herring Gull		x	x			x	x						x
HerringXGlaucous-winged Gull		x								x			
Thayer's Gull			x	x	x	x	x	x	x	x	x		x
California Gull		x	x	x	x	x		x	x		x		

Table 4. (Continued)

Species	Region 1*	2	3	4	5	6	7	8	9	10	11	12	13
Ring-billed Gull		x	x		x	x						x	
Mew Gull		x	x	x	x	x	x	x	x	x	x	x	x
Dark gull (dk primaries)		x	x		x	x			x				
Franklin's Gull					x								
Bonaparte's Gull		x	x	x	x	x	x	x	x	x	x	x	x
Heermann's Gull		x	x	x	x	x	x	x	x		x	x	x
Black-legged Kittiwake		x	x										
Small Gull			x		x	x		x	x	x			
Gull sp.		x	x	x	x	x	x	x	x	x	x	x	x
ALCIDS													
Common Murre		x	x	x	x	x	x	x	x	x	x	x	x
Pigeon Guillemot		x	x	x	x	x	x	x	x	x	x	x	x
Marbled Murrelet		x	x	x	x	x	x	x	x	x	x	x	x
Ancient Murrelet		x	x	x	x	x		x	x	x	x	x	x
Rhinoceros Auklet		x	x	x	x	x	x	x	x		x	x	x
Murrelet sp.			x	x	x	x		x	x	x	x	x	x
Alcid sp.		x	x	x	x	x	x	x	x	x	x		

Note: *Not censused during period.

APPENDIX IV

Regional and Subregional Summaries of Bird Family Densities, Projected Totals, and Bird Oil Indices.

Section A

Region 1. Swiftsure Bank region, subregional seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Swiftsure Bank Region, Swiftsure Bank Subregion (0101)

			Period			
Family	Area		Spring*	Summer	Fall	Winter*
Loons	W	D=			0.08	
		PT=			60	
		BOI=			1.12	
Albatrosses	W	D=			0.04	
		PT=			30	
		BOI=			0.35	
Shearwaters	W	D=		27.33	2.35	
		PT=		23,000	2,000	
		BOI=		151.84	12.64	
Storm-Petrels	W	D=		11.17	0.64	
		PT=		9,400	540	
		BOI=		80.46	4.64	
Ducks and Geese	W	D=			0.04	
		PT=			30	
		BOI=			0.27	
Sandpipers and other shorebirds	W	D=		0.33		
		PT=		280		
		BOI=		1.29		
Phalaropes	W	D=			0.49	
		PT=			410	
		BOI=			2.76	

Table 1. *(Continued)*

			Period			
Family	Area		Spring*	Summer	Fall	Winter*
Jaegers	W	D=			0.23	
		PT=			190	
		BOI=			0.17	
Gulls and Terns	W	D=		38.33	14.32	
		PT=		32,000	12,000	
		BOI=		577.82	154.19	
Alcids	W	D=		14.83	22.73	
		PT=		12,000	19,000	
		BOI=		176.06	613.11	
Summary	W	D=		92.17	41.63	
		PT=		77,000	35,000	
		BOI=		987.47	789.24	

*No data are available.
SUMS = summary
W = water
S = shoreline

Section B

Region 2. Strait of Juan de Fuca-Outer, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Strait of Juan de Fuca (Outer) Subregion (0201)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=				0.10
		PT=				180
		BOI=				3.44
Grebes	W	D=				0.27
		PT=				500
		BOI=				10.10
Shearwaters	W	D=			0.26	
		PT=			490	
		BOI=			3.21	
Storm-Petrels	W	D=			0.08	0.05
		PT=			150	90
		BOI=			1.26	0.79
Cormorants	W	D=	0.14		0.44	0.49
		PT=	270		830	920
		BOI=	6.24		14.63	19.75
Ducks and Geese	W	D=	0.34			0.39
		PT=	640			730
		BOI=	9.92			16.64
Eagles and Hawks	W	D=			1.09[1]	
		PT=			1	
		BOI=			0.01	

Table 1. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Phalaropes	W	D=			5.68	0.10
		PT=			11,000	180
		BOI=			71.22	0.48
Gulls and Terns	W	D=	15.22	0.78	9.30	5.86
		PT=	29,000	1,500	18,000	11,000
		BOI=	328.89	21.82	236.11	166.00
Alcids	W	D=	0.92	3.45	73.12	21.51
		PT=	1,700	6,500	140,000	41,000
		BOI=	67.33	209.55	4450.44	1308.10
Summary	W	D=	16.62	4.31	89.22	28.91
		PT=	31,000	8,000	170,000	54,000
		BOI=	412.38	231.38	4803.87	1525.30

[1] Numbers adjusted to allow for small sample size.
SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Vancouver Island Subregion (0202)

			Period			
Family	Area		Spring	Summer*	Fall	Winter
Loons	S	D=	0.70		1.96	0.70
		PT=	40		100	40
		BOI=	0.54		1.89	0.54
Grebes	S	D=	0.18		13.21	2.63
		PT=	9		680	140
		BOI=	0.15		17.28	2.97
Cormorants	S	D=	49.82		0.89	15.79
		PT=	2,600		50	810
		BOI=	58.59		0.80	18.34
Herons	S	D=			0.71	
		PT=			40	
		BOI=			0.19	
Ducks and Geese	S	D=	2.63		25.00	7.54
		PT=	140		1,300	390
		BOI=	2.81		24.10	7.28
Eagles and Hawks	S	D=			0.36	0.18
		PT=			20	9
		BOI=			0.13	0.06
Oystercatchers	S	D=				0.18
		PT=				9
		BOI=				0.20

Table 2. (Continued)

			Period			
Family	Area		Spring	Summer*	Fall	Winter
Gulls and Terns	S	D=	32.28		210.71	51.75
		PT=	1,700		11,000	2,700
		BOI=	27.92		186.59	49.72
Alcids	S	D=			2.32	2.11
		PT=			120	110
		BOI=			3.98	3.50
Summary	S	D=	85.61		255.18	80.88
		PT=	4,400		13,000	4,200
		BOI=	90.00		234.96	82.61

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Cape Flattery Subregion (0203)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.16		0.27	1.33
		PT=	1		1	7
		BOI=	0.01		0.03	0.11
Grebes	S	D=	3.65		0.54	1.33
		PT=	20		3	7
		BOI=	0.57		0.09	0.13
Cormorants	S	D=	81.9	68.57	78.38	51.33
		PT=	440	370	420	280
		BOI=	10.10	8.43	9.67	6.07
Herons	S	D=				0.22
		PT=				1
		BOI=				0.01
Ducks and Geese	S	D=	11.43	0.71	2.16	8.22
		PT=	60	4	10	40
		BOI=	1.39	0.10	0.29	0.92
Eagles and Hawks	S	D=				0.22
		PT=				1
		BOI=				0.01
Oystercatchers	S	D=	0.32	1.43		
		PT=	2	8		
		BOI=	0.04	0.17		

Table 3. (Continued)

Family	Area		Spring	Summer	Fall	Winter
			Period			
Phalaropes	S	D=	12.86			
		PT=	70			
		BOI=	0.46			
Gulls and Terns	S	D=	583.02	2967.86	974.59	465.78
		PT=	3,100	16,000	5,300	2,500
		BOI=	58.13	303.22	87.40	45.61
Alcids	S	D=	43.81	156.43	1.89	3.33
		PT=	240	840	10	20
		BOI=	7.78	26.99	0.33	0.59
Summary	S	D=	737.14	3200.71	1058.92	532.44
		PT=	4,000	17,000	5,700	2,900
		BOI=	78.49	338.91	97.81	53.45

SUMS = summary
W = water
S = shoreline

Table 4. *Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Neah Bay Subregion (0204)*

Family	Area		Period			
			Spring	Summer	Fall	Winter
Loons	S	D=	1.11	0.22	0.74	1.83
		PT=	5	1	3	8
		BOI=	0.08	0.01	0.06	0.13
Grebes	S	D=	16.22		24.44	16.94
		PT=	70		110	80
		BOI=	1.47		1.84	0.48
Cormorants	S	D=	1.56	1.89	11.41	
		PT=	7	9	50	
		BOI=	0.16	0.17	1.11	
Herons	S	D=	0.15	0.11	0.22	0.11
		PT=	1	1	1	1
		BOI=	<0.01	<0.01	0.01	<0.01
Ducks and Geese	S	D=	70.52	7.44	61.85	78.33
		PT=	320	30	280	350
		BOI=	5.46	0.70	5.69	5.18
Rails	S	D=	2.52		1.11	3.61
		PT=	10		5	20
		BOI=	0.03		0.01	0.05
Oystercatchers	S	D=	0.15			
		PT=	1			
		BOI=	0.01			

Table 4. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sandpipers and other shorebirds	S	D=	12.89	13.67	7.93	8.06
		PT=	60	60	40	40
		BOI=	0.40	0.35	0.25	0.33
Gulls and Terns	S	D=	13.33	138.00	161.85	22.94
		PT=	60	620	730	100
		BOI=	1.09	10.05	10.99	1.74
Alcids	S	D=	2.07	2.44	0.15	0.11
		PT=	9	10	1	1
		BOI=	0.48	0.51	0.02	0.02
Summary	S	D=	120.52	163.78	269.70	136.89
		PT=	540	740	1,200	620
		BOI=	9.18	11.80	19.98	9.46

SUMS = summary
W = water
S = shoreline

Table 5. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Neah Bay to Clallam Bay Subregion (0205)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.59		0.76	2.91
		PT=	8		10	40
		BOI=	0.13		0.17	0.70
Grebes	S	D=	0.59		2.28	25.55
		PT=	8		30	330
		BOI=	0.12		0.64	7.28
Cormorants	S	D=	16.76	15.81	37.47	25.64
		PT=	220	200	480	330
		BOI=	4.87	4.28	10.68	7.03
Herons	S	D=	0.15		0.25	0.18
		PT=	2		3	2
		BOI=	0.01		0.02	0.01
Ducks and Geese	S	D=	22.50	42.26	57.72	97.00
		PT=	290	550	750	1,300
		BOI=	6.23	13.49	17.70	20.30
Eagles and Hawks	S	D=	0.07		0.13	0.45
		PT=	1		2	6
		BOI=	0.01		0.01	0.04
Oystercatchers	S	D=				0.09
		PT=				1
		BOI=				0.03

Table 5. *(Continued)*

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sandpipers and other shorebirds	S	D=			0.89	1.82
		PT=			10	20
		BOI=			0.05	0.11
Phalaropes	S	D=			0.13	
		PT=			2	
		BOI=			0.01	
Gulls and Terns	S	D=	40.59	283.23	207.72	102.27
		PT=	520	3,700	2,700	1,300
		BOI=	9.86	54.00	38.44	22.10
Alcids	S	D=	4.85	14.52	68.10	0.18
		PT=	60	190	880	2
		BOI=	1.76	1.95	28.28	0.08
Summary	S	D=	86.10	355.81	376.71	261.36
		PT=	1,100	4,600	4,900	3,400
		BOI=	22.98	73.52	96.00	57.67

SUMS = summary
W = water
S = shoreline

Table 6. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Clallam Bay Subregion (0206)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.16	0.15	0.68	1.91
		PT=	4	<1	2	6
		BOI=	0.06	0.01	0.05	0.12
Grebes	S	D=	5.62		9.73	25.09
		PT=	20		30	80
		BOI=	0.42		0.66	1.98
Cormorants	S	D=	3.08	2.06	8.65	9.55
		PT=	10	7	30	30
		BOI=	0.18	0.14	0.52	0.60
Herons	S	D=				0.09
		PT=				<1
		BOI=				<0.01
Ducks and Geese	S	D=	31.23	2.65	29.32	49.27
		PT=	100	8	90	160
		BOI=	2.01	0.19	2.15	3.03
Eagles and Hawks	S	D=				0.09
		PT=				<1
		BOI=				<0.01
Plovers	S	D=		0.15	0.54	0.27
		PT=		<1	2	1
		BOI=		<0.01	0.01	<0.01

Table 6. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sandpipers and other shorebirds	S	D=				1.91
		PT=				6
		BOI=				0.07
Phalaropes	S	D=			1.89	
		PT=			6	
		BOI=			0.04	
Gulls and Terns	S	D=	10.68	38.82	208.11	19.55
		PT=	30	120	670	60
		BOI=	0.56	1.43	6.67	0.75
Alcids	S	D=	0.07	2.35	0.14	0.55
		PT=	<1	8	<1	2
		BOI=	0.01	0.35	0.02	0.09
Summary	S	D=	51.99	46.18	259.05	109.45
		PT=	170	150	830	350
		BOI=	3.24	2.12	10.11	6.65

SUMS = summary
W = water
S = shoreline

Table 7. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Clallam Bay to Crescent Bay Subregion (0207)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	2.47	0.22	1.41	1.91
		PT=	50	5	30	40
		BOI=	0.88	0.07	0.47	0.69
Grebes	S	D=	7.95		6.54	13.51
		PT=	170		140	280
		BOI=	3.58		2.93	6.38
Cormorants	S	D=	5.73	2.33	14.10	18.51
		PT=	120	50	290	390
		BOI=	2.65	1.05	6.43	7.92
Herons	S	D=	0.33	0.44	0.15	0.11
		PT=	7	9	3	2
		BOI=	0.04	0.05	0.02	0.01
Ducks and Geese	S	D=	118.62	0.78	26.98	121.99
		PT=	2,500	20	560	2,500
		BOI=	64.9	0.34	12.03	35.88
Eagles and Hawks	S	D=	0.08			0.18
		PT=	2			4
		BOI=	0.01			0.03
Oystercatchers	S	D=				0.11
		PT=				2
		BOI=				0.05

Table 7. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Plovers	S	D=			0.34	0.11
		PT=			7	2
		BOI=			0.01	0.01
Sandpipers and other shorebirds	S	D=	0.38		7.85	1.60
		PT=	8		160	30
		BOI=	0.04		0.78	0.23
Gulls and Terns	S	D=	22.26	111.67	160.00	89.96
		PT=	460	2,300	3,300	1,900
		BOI=	8.07	26.19	37.43	28.07
Alcids	S	D=	0.92	3.56	1.46	0.28
		PT=	20	70	30	6
		BOI=	0.70	2.92	1.01	0.29
Summary	S	D=	158.74	119.00	219.61	262.52
		PT=	3,300	2,500	4,600	5,500
		BOI=	80.88	30.62	61.10	79.56

SUMS = summary
W = water
S = shoreline

Table 8. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Crescent Bay Subregion (0208)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	3.00	3.08	2.55	2.86
		PT=	3	3	3	3
		BOI=	0.06	0.05	0.04	0.06
Grebes	S	D=	4.00		3.33	30.63
		PT=	4		4	30
		BOI=	0.09		0.07	0.77
Cormorants	S	D=	11.50	21.54	6.27	15.87
		PT=	10	20	7	20
		BOI=	0.26	0.54	0.15	0.37
Herons	S	D=	0.50	0.77	0.39	0.63
		PT=	1	1	<1	1
		BOI=	<0.01	<0.01	<0.01	<0.01
Ducks and Geese	S	D=	67.25	2.31	12.94	92.38
		PT=	70	3	10	100
		BOI=	1.38	0.06	0.29	1.78
Eagles and Hawks	S	D=			0.20	
		PT=			<1	
		BOI=			<0.01	
Oystercatchers	S	D=	1.25		1.37	5.08
		PT=	1		2	6
		BOI=	0.03		0.03	0.12

Table 8. (Continued)

Family	Area		Period Spring	Summer	Fall	Winter
Plovers	S	D=	0.75		3.92	0.32
		PT=	1		4	<1
		BOI=	<0.01		0.01	<0.01
Sandpipers and other shorebirds	S	D=	4.50	4.62	8.82	10.32
		PT=	5	5	10	10
		BOI=	0.03	0.02	0.05	0.13
Gulls and Terns	S	D=	95.75	56.92	163.53	21.11
		PT=	110	60	180	20
		BOI=	1.89	1.00	2.15	0.40
Alcids	S	D=	28.00	0.77	1.57	0.63
		PT=	30	1	2	1
		BOI=	1.48	0.03	0.07	0.03
Summary	S	D=	217.00	91.54	204.90	180.00
		PT=	240	100	230	200
		BOI=	5.23	1.70	2.87	3.65

SUMS = summary
W = water
S = shoreline

Table 9. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Outer Region, Crescent Bay to Ediz Hook Subregion (0209)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	4.57		1.23	3.07
		PT=	40		10	30
		BOI=	0.79		0.18	0.48
Grebes	S	D=	8.71		8.90	11.82
		PT=	80		80	110
		BOI=	1.51		1.93	2.04
Cormorants	S	D=	7.43	1.36	8.36	28.52
		PT=	70	10	80	260
		BOI=	1.53	0.28	1.69	5.45
Herons	S	D=	0.29		0.68	0.80
		PT=	3		6	7
		BOI=	0.01		0.03	0.04
Ducks and Geese	S	D=	220.57		12.88	153.18
		PT=	2,000		120	1,400
		BOI=	20.73		2.57	17.92
Eagles and Hawks	S	D=				0.11
		PT=				1
		BOI=				0.01
Plovers	S	D=	0.86			
		PT=	8			
		BOI=	0.03			

Table 9. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sandpipers and other shorebirds	S	D=	12.71			
		PT=	110			
		BOI=	0.60			
Gulls and Terns	S	D=	279.14	103.18	433.84	495.11
		PT=	2,500	930	3,900	4,500
		BOI=	43.49	17.52	60.50	79.30
Alcids	S	D=	4.14	8.64	28.08	0.23
		PT=	40	80	250	2
		BOI=	1.42	2.69	8.36	0.07
Summary	S	D=	538.57	113.18	497.53	693.30
		PT=	4,800	1,000	4,500	6,200
		BOI=	70.11	20.48	75.26	105.30

SUM = summary
W = water
S = shoreline

Section C

Region 3. Strait of Juan de Fuca-Inner, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not presented indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Strait of Juan de Fuca (Inner) Subregion (0301)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=	0.08	0.01	0.18	0.40
		PT=	130	10	300	660
		BOI=	2.25	0.14	5.81	13.61
Grebes	W	D=	0.19	0.03	3.66	0.52
		PT=	310	50	6,000	840
		BOI=	5.18	1.44	94.44	15.74
Shearwaters	W	D=		0.02	0.05	
		PT=		30	80	
		BOI=		0.19	0.51	
Storm-Petrels	W	D=		0.05	0.01	
		PT=		80	20	
		BOI=		0.65	0.19	
Cormorants	W	D=	0.20	0.09	0.95	1.17
		PT=	330	140	1,600	1,900
		BOI=	7.53	2.89	34.17	37.99
Herons	W	D=			0.03	
		PT=			40	
		BOI=			0.22	
Ducks and Geese	W	D=	0.16	0.06	3.43	4.91
		PT=	260	100	5,600	8,000
		BOI=	6.52	1.38	133.65	163.19

Table 1. *(Continued)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Oystercatchers	W	D=	0.01			0.01
		PT=	10			10
		BOI=	0.21			0.27
Plovers	W	D=		0.02		
		PT=		30		
		BOI=		0.12		
Sandpipers and other shorebirds	W	D=			0.02	
		PT=			30	
		BOI=			0.11	
Phalaropes	W	D=			0.54	0.01
		PT=			880	10
		BOI=			5.73	0.02
Jaegers	W	D=			0.01	
		PT=			10	
		BOI=			0.02	
Gulls and Terns	W	D=	2.61	3.35	14.85	20.99
		PT=	4,300	5,500	24,000	34,000
		BOI=	59.60	91.12	363.38	479.46
Alcids	W	D=	5.19	1.15	17.38	12.71
		PT=	8,500	1,900	28,000	21,000
		BOI=	391.96	80.11	932.21	672.78

Table 1. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
Summary	W	D=	8.44	4.77	41.36	40.72
		PT=	14,000	7,800	67,000	66,000
		BOI=	473.05	178.24	1570.45	1383.05

SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Ediz Hook Subregion (0302)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.42		0.88	1.06
		PT=	<1		<1	<1
		BOI=	<0.01		<0.01	0.01
Grebes	S	D=	5.53		3.52	6.09
		PT=	2		1	2
		BOI=	0.04		0.02	0.05
Cormorants	S	D=	2.50	1.86	2.48	2.37
		PT=	1	1	1	1
		BOI=	0.02	0.02	0.02	0.02
Herons	S	D=	0.07		0.02	
		PT=	<1		<1	
		BOI=	<0.01		<0.01	
Ducks and Geese	S	D=	10.88	0.06	7.32	8.96
		PT=	4	<1	3	4
		BOI=	0.09	<0.01	0.06	0.07
Eagles and Hawks	S	D=				0.08
		PT=				<1
		BOI=				<0.01
Oystercatchers	S	D=		0.06		
		PT=		<1		
		BOI=		<0.01		

Table 2. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Plovers	S	D=			0.07	0.18
		PT=			<1	<1
		BOI=			<0.01	<0.01
Sandpipers and other shorebirds	S	D=	0.04	0.17	0.46	0.25
		PT=	<1	<1	<1	<1
		BOI=	<0.01	<0.01	<0.01	<0.01
Phalaropes	S	D=			4.99	
		PT=			2	
		BOI=			0.01	
Gulls and Terns	S	D=	8.42	23.26	37.60	11.10
		PT=	3	9	20	4
		BOI=	0.06	0.14	0.22	0.08
Alcids	S	D=	6.16	3.20	18.07	0.92
		PT=	2	1	7	<1
		BOI=	0.11	0.06	0.31	0.01
Summary	S	D=	34.08	28.66	75.54	31.15
		PT=	10	10	30	10
		BOI-	0.32	0.22	0.66	0.23

SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Port Angeles Subregion (0303)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.45	0.04	0.42	0.86
		PT=	5	<1	4	9
		BOI=	0.07	0.01	0.08	0.15
Grebes	S	D=	11.09		7.51	23.29
		PT=	120		80	240
		BOI=	2.90		1.42	5.66
Cormorants	S	D=	8.35	11.93	12.88	7.63
		PT=	90	120	130	80
		BOI=	1.96	2.84	2.96	1.71
Herons	S	D=	0.02		0.90	1.10
		PT=	<1		9	10
		BOI=	<0.01		0.05	0.06
Ducks and Geese	S	D=	18.58	0.66	47.77	57.30
		PT=	190	7	500	600
		BOI=	4.29	0.13	6.37	10.48
Rails	S	D=	0.06		0.01	0.21
		PT=	1		<1	2
		BOI=	<0.01		<0.01	0.01
Oystercatchers	S	D=	0.12	0.12		
		PT=	1	1		
		BOI=	0.03	0.03		

Table 3. (Continued)

Family	Area		Period Spring	Summer	Fall	Winter
Plovers	S	D=	0.78	0.04	1.29	2.04
		PT=	8	<1	10	20
		BOI=	0.04	<0.01	0.07	0.11
Sandpipers and other shorebirds	S	D=	5.99	3.17	7.93	10.11
		PT=	60	30	80	110
		BOI=	0.40	0.19	0.54	0.75
Gulls and Terns	S	D=	17.04	27.65	207.03	57.87
		PT=	180	290	2,200	600
		BOI=	3.30	5.10	30.70	9.15
Alcids	S	D=	2.80	1.36	0.90	4.35
		PT=	30	10	9	50
		BOI=	1.36	0.66	0.38	1.67
Summary	S	D=	65.29	44.98	286.63	164.77
		PT=	680	470	3,000	1,700
		BOI=	14.35	8.95	42.56	29.75

SUMS = summary
W = water
S = shoreline

Table 4. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Voice of America Subregion (0304)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.68	0.75	1.75	2.49
		PT=	40	20	40	60
		BOI=	0.78	0.38	0.78	1.14
Grebes	S	D=	4.60		437.37	12.00
		PT=	110		10	290
		BOI=	2.13		7.68	6.19
Cormorants	S	D=	3.51	2.73	6.46	6.94
		PT=	80	70	160	170
		BOI=	1.92	1.46	3.49	3.75
Herons	S	D=			0.09	0.02
		PT=			2	1
		BOI=			0.01	<0.01
Ducks and Geese	S	D=	28.67	52.04	42.19	66.03
		PT=	690	1,200	1,000	1,600
		BOI=	13.44	26.71	21.76	24.66
Eagles and Hawks	S	D=	0.11			0.04
		PT=	3			1
		BOI=	0.02			0.01
Plovers	S	D=	0.02		0.11	0.01
		PT=	1		3	<1
		BOI=	<0.01		0.01	<0.01

Table 4. (Continued)

Family	Area		Spring	Summer	Fall	Winter
			Period			
Sandpipers and other shorebirds	S	D=			0.16	
		PT=			4	
		BOI=			0.02	
Gulls and Terns	S	D=	61.66	99.44	103.20	71.34
		PT=	1,500	2,400	2,500	1,700
		BOI=	24.75	37.22	36.05	18.53
Alcids	S	D=	27.86	11.00	18.94	1.02
		PT=	670	260	450	30
		BOI=	33.00	12.14	21.15	1.05
Summary	S	D=	128.17	165.99	191.77	160.00
		PT=	3,100	4,000	4,600	3,800
		BOI=	76.06	77.91	90.95	55.34

SUMS = summary
W = water
S = shoreline

Table 5. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Dungeness Spit Subregion (0305)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	4.29	0.43	6.20	5.88
		PT=	20	2	30	20
		BOI=	0.34	0.04	0.41	0.43
Grebes	S	D=	14.16	3.91	16.50	10.70
		PT=	60	20	70	40
		BOI=	0.84	0.47	0.81	0.78
Cormorants	S	D=	7.66	23.48	14.60	8.60
		PT=	30	90	60	30
		BOI=	0.67	2.11	1.27	0.75
Herons	S	D=	0.26		73.50	
		PT=	1		290	
		BOI=	0.01		1.48	
Ducks and Geese	S	D=	84.03	7.39	64.40	712.98
		PT=	340	30	260	2,900
		BOI=	6.87	0.74	5.05	22.95
Eagles and Hawks	S	D=				0.09
		PT=				<1
		BOI=				<0.01
Oystercatchers	S	D=		0.43		0.26
		PT=		2		1
		BOI=		0.04		0.02

Table 5. *(Continued)*

Family	Area	Spring	Summer	Fall	Winter
			Period		
Plovers	S D=		1.30	212.70	8.33
	PT=		5	850	30
	BOI=		0.01	4.30	0.17
Sandpipers and other shorebirds	S D=	0.65	17.39	74.40	48.86
	PT=	3	70	300	200
	BOI=	0.01	0.36	1.63	1.00
Gulls and Terns	S D=	31.56	454.35	665.00	92.46
	PT=	130	1,700	2,700	370
	BOI=	2.35	28.48	39.91	5.73
Alcids	S D=	18.44	11.74	70.70	8.16
	PT=	70	50	280	30
	BOI=	3.39	1.84	11.98	1.17
Summary	S D=	161.04	490.87	1199.90	897.37
	PT=	640	2,000	4,800	3,600
	BOI=	14.48	34.11	66.84	32.99

SUMS = summary
W = water
S = shoreline

Table 6. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Dungeness Bay/Harbor Subregion (0306)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Loons	S	D=	2.52	0.34	2.14	3.88
		PT=	30	4	30	50
		BOI=	0.57	0.07	0.40	0.85
Grebes	S	D=	19.10	0.04	6.78	6.66
		PT=	230	<1	80	80
		BOI=	5.69	0.01	1.15	1.61
Shearwaters	S	D=			0.01	
		PT=			<1	
		BOI=			<0.01	
Cormorants	S	D=	4.23	6.78	17.21	5.69
		PT=	50	80	210	70
		BOI=	1.13	1.82	4.31	1.53
Herons	S	D=	0.17	2.80	1.95	0.38
		PT=	2	30	20	5
		BOI=	0.01	0.17	0.12	0.02
Ducks and Geese	S	D=	279.38	19.31	187.09	484.16
		PT=	3,400	230	2,200	5,800
		BOI=	85.51	4.96	28.24	69.43
Eagles and Hawks	S	D=				0.03
		PT=				<1
		BOI=				<0.01

Table 6. *(Continued)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Rails	S	D=	0.78			
		PT=	9			
		BOI=	0.03			
Oystercatchers	S	D=	0.13	0.31	0.11	0.03
		PT=	2	4	1	<1
		BOI=	0.03	0.08	0.03	0.01
Plovers	S	D=	12.93	12.76	20.34	46.23
		PT=	160	150	240	560
		BOI=	0.79	0.71	1.21	2.82
Sandpipers and other shorebirds	S	D=	98.82	40.57	65.46	100.06
		PT=	1,200	490	790	1,200
		BOI=	6.11	2.57	3.66	6.13
Jaegers	S	D=			0.02	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	82.61	150.88	293.86	82.30
		PT=	990	1,800	3,500	1,000
		BOI=	15.44	30.56	48.28	13.94
Alcids	S	D=	11.37	9.12	4.79	0.35
		PT=	140	110	60	4
		BOI=	4.55	3.74	2.25	0.16

Table 6. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Summary	S	D=	512.04	243.10	600.01	729.81
		PT=	6,100	2,900	7,200	8,800
		BOI=	119.86	44.71	89.66	96.50

SUMS = summary
W = water
S = shoreline

Table 7. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Jamestown Subregion (0307)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.47	1.54	2.35	2.81
		PT=	30	30	50	60
		BOI=	0.49	0.49	0.80	0.97
Grebes	S	D=	3.67		12.04	39.92
		PT=	80		260	850
		BOI=	1.34		4.26	22.48
Cormorants	S	D=	4.13	3.85	3.89	10.00
		PT=	90	80	80	210
		BOI=	1.93	1.73	1.81	4.81
Herons	S	D=		3.85	3.09	
		PT=		80	70	
		BOI=		0.41	0.33	
Ducks and Geese	S	D=	473.85	80.77	1574.20	1951.57
		PT=	10,000	1,700	34,000	42,000
		BOI=	254.16	19.01	248.27	518.92
Eagles and Hawks	S	D=				0.25
		PT=				5
		BOI=				0.04
Plovers	S	D=	5.87		16.73	1.16
		PT=	130		360	30
		BOI=	0.64		1.80	0.13

Table 7. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
Sandpipers and other shorebirds	S	D=	72.02		23.95	45.95
		PT=	1,500		510	980
		BOI=	7.87		2.34	5.12
Jaegers	S	D=			0.06	
		PT=			1	
		BOI=			<0.01	
Gulls and Terns	S	D=	224.13	916.92	307.04	106.12
		PT=	4,800	20,000	6,600	2,300
		BOI=	79.15	371.45	78.76	34.38
Alcids	S	D=	4.22	13.08	6.05	1.40
		PT=	90	280	130	30
		BOI=	3.24	9.67	4.61	1.06
Summary	S	D=	789.36	1023.08	1956.73	2159.17
		PT=	17,000	22,000	42,000	46,000
		BOI=	348.82	402.77	342.89	587.90

SUMS = summary
W = water
S = shoreline

Table 8. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Sequim Bay Subregion (0308)

				Period		
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.32		2.20	1.81
		PT=	20		40	30
		BOI=	0.37		0.62	0.56
	W	D=	0.57		2.35	0.87
		PT=	9		40	10
		BOI-	0.17		0.75	0.29
	Sums	PT=	30		80	40
		BOI=	0.54		1.37	0.85
Grebes	S	D=	8.77		31.67	25.07
		PT=	140		510	400
		BOI=	3.42		13.32	8.96
	W	D=	3.62		59.21	1.85
		PT=	60		950	30
		BOI=	1.68		27.31	0.66
	Sums	PT=	200		1,500	430
		BOI=	5.10		40.63	9.62
Cormorants	S	D=	0.80		1.05	1.50
		PT=	10		20	20
		BOI=	0.25		0.37	0.48
	W	D=	0.10			0.38
		PT=	2			6
		BOI=	0.04			0.14

Table 8. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sums		PT=	10		20	30
		BOI=	0.29		0.37	0.62
Herons	S	D=	0.54	1.05	0.75	0.25
		PT=	10	20	10	4
		BOI=	0.04	0.09	0.06	0.02
Ducks and Geese	S	D=	78.99		95.33	203.07
		PT=	1,300		1,500	3,300
		BOI=	23.53		17.52	43.43
	W	D=	12.11	1.03	0.83	14.53
		PT=	200	120	10	230
		BOI=	4.08	0.34	0.33	3.93
Sums		PT=	1,500	120	1,500	3,500
		BOI=	27.61	0.34	17.85	18.46
Eagles and Hawks	S	D=	0.01	0.01	0.02	0.08
		PT=	<1	<1	1	1
		BOI=	<0.01	<0.01	<0.01	0.01
Rails	S	D=	0.60		1.80	2.63
		PT=	10		30	40
		BOI=	0.03		0.08	0.12
Oystercatchers	S	D=	0.35		0.10	0.27
		PT=	6		1	4
		BOI=	0.12		0.04	0.10

Table 8. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Plovers	S	D=	4.26		3.47	0.34
		PT=	70		60	5
		BOI=	0.35		0.29	0.01
Sandpipers and other shorebirds	S	D=	27.20		11.98	33.21
		PT=	440		190	530
		BOI=	2.34		0.98	2.82
Jaegers	S	D=			0.05	
		PT=			1	
		BOI=			<0.01	
Gulls and Terns	S	D=	22.74	27.22	115.16	9.83
		PT=	370	440	1,900	160
		BOI=	6.33	8.30	31.49	2.59
	W	D=	0.67	0.21	10.90	0.78
		PT=	10	3	180	10
		BOI=	0.18	0.03	2.00	0.16
Sums		PT=	380	440	2,100	170
		BOI=	6.51	8.33	33.49	2.75
Alcids	S	D=	4.77	1.05	7.83	2.65
		PT=	80	20	130	40
		BOI=	2.82	0.58	4.42	1.45
	W	D=	0.36		8.56	1.59
		PT=	6		140	30
		BOI=	0.21		5.33	0.97

Table 8. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sums		PT=	90	20	270	70
		BOI=	3.03	0.58	9.75	2.42
Summary	S	D=	150.41	29.32	272.08	283.07
		PT=	2,400	470	4,400	4,600
		BOI=	39.59	8.96	69.19	60.55
	W	D=	17.44	1.24	82.13	20.83
		PT=	280	20	1,300	340
		BOI=	6.35	0.37	35.72	6.15
Sums		PT=	2,700	490	5,700	4,900
		BOI=	45.94	9.33	104.91	66.70

SUMS = summary
W = water
S = shoreline

Table 8. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Miller Peninsula Subregion (0309)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.38		0.46	6.00
		PT=	7		2	30
		BOI=	0.11		0.03	0.47
Grebes	S	D=	9.85		2.46	13.50
		PT=	50		10	70
		BOI=	0.80		0.21	1.14
Cormorants	S	D=	7.54	11.00	2.62	25.25
		PT=	40	50	10	120
		BOI=	0.83	0.73	0.29	2.56
Herons	S	D=			0.46	
		PT=			2	
		BOI=			0.01	
Ducks and Geese	S	D=	56.62	4.00	14.46	747.25
		PT=	270	20	70	3,600
		BOI=	4.99	0.49	1.61	65.89
Eagles and Hawks	S	D=	0.15		0.15	0.25
		PT=	1		1	1
		BOI=	0.01		<0.01	0.01
Sandpipers and other shorebirds	S	D=			15.38	
		PT=			70	
		BOI=			0.39	

Table 9. *(Continued)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Gulls and Terns	S	D=	20.31	173.00	72.92	31.50
		PT=	100	830	350	150
		BOI=	1.81	15.72	4.41	2.69
Alcids	S	D=	20.92	8.00	15.69	7.25
		PT=	100	40	80	40
		BOI=	3.95	1.33	2.39	1.19
Summary	S	D=	116.77	197.00	134.00	836.25
		PT=	560	950	640	4,000
		BOI=	12.49	18.27	9.35	73.95

SUMS = summary
W = water
S = shoreline

Table 10. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Protection Island Subregion (0310)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.09		0.14	1.74
		PT=	1		2	20
		BOI=	0.02		0.04	0.42
Grebes	S	D=	1.67		7.27	28.00
		PT=	20		100	390
		BOI=	0.41		1.82	10.28
Cormorants	S	D=	6.99	82.77	17.84	10.78
		PT=	100	1,200	250	150
		BOI=	2.22	26.29	5.67	3.35
Herons	S	D=			0.07	
		PT=			1	
		BOI=			0.01	
Ducks and Geese	S	D=	34.51	1.98	12.73	102.96
		PT=	480	30	180	1,400
		BOI=	12.84	0.58	3.83	16.25
Eagles and Hawks	S	D=	0.09			0.12
		PT=	1			2
		BOI=	0.01			0.01
Oystercatchers	S	D=	0.12		2.52	
		PT=	2		40	
		BOI-	0.04		0.77	

Table 10. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sandpipers and other shorebirds	S	D=				1.49
		PT=				20
		BOI=				0.10
Gulls and Terns	S	D=	99.83	436.87	272.52	35.68
		PT=	1,400	6,100	3,800	500
		BOI=	26.25		61.13	8.86
Alcids	S	D=	25.71	63.44	10.50	4.34
		PT=	360	880	150	60
		BOI=	12.53	30.40	5.20	2.38
Summary	S	D=	169.09	585.06	329.86	201.83
		PT=	2,400	8,100	4,600	2,800
		BOI=	54.32	172.23	78.47	41.64

SUMS = summary
W = water
S = shoreline

Table 11. *Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Discovery Bay Subregion (0311)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.54	0.22	2.57	2.63
		PT=	10	3	20	30
		BOI=	0.26	0.03	0.45	0.47
	W	D=	1.92		2.48	2.90
		PT=	80		110	130
		BOI=	1.90		2.17	2.54
	Sums	PT=	90	3	130	160
		BOI=	2.16	0.03	2.62	3.01
Grebes	S	D=	29.93		48.91	37.46
		PT=	290		470	360
		BOI=	7.83		10.08	9.29
	W	D=	31.01		1.30	35.35
		PT=	1,400		60	1,500
		BOI=	40.68		1.48	46.02
	Sums	PT=	1,700		530	1,900
		BOI=	48.51		11.56	55.31
Cormorants	S	D=	0.73	0.64	2.19	1.69
		PT=	7	7	20	20
		BOI=	0.15	0.11	0.45	0.34
	W	D=			0.12	0.27
		PT=			6	10
		BOI=			0.10	0.27

Table 11. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
Sums		PT=	7	7	30	30
		BOI=	0.15	0.11	0.55	0.61
Herons	S	D=	0.80	0.51	1.25	0.07
		PT=	8	5	10	<0.01
		BOI=	0.04	0.03	0.05	<0.01
Ducks and Geese	S	D=	132.38	2.46	86.10	294.03
		PT=	1,300	20	830	2,800
		BOI=	28.53	0.56	17.75	46.33
	W	D=	21.66		3.78	41.59
		PT=	950		170	1,800
		BOI=	23.42		2.19	41.82
Sums		PT=	2,300	20	1,000	4,600
		BOI=	51.95	0.56	19.94	88.15
Eagles and Hawks	W	D=	0.01			
		PT=	<1			
		BOI=	<0.01			
Rails	S	D=	1.49		3.98	5.05
		PT=	10		40	50
		BOI=	0.04		0.11	0.14
Plovers	S	D=	0.07	0.05		0.49
		PT=	1	1		4
		BOI=	<0.01	<0.01		<0.01

Table 11. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sandpipers and other shorebirds	S	D=	8.31		0.04	1.14
		PT=	80		1	10
		BOI=	0.33		<0.01	0.05
Gulls and Terns	S	D=	22.79	15.83	33.00	39.04
		PT=	220	150	320	380
		BOI=	3.89	2.79	4.47	5.58
	W	D=	5.51	2.58	10.04	15.10
		PT=	240	110	440	660
		BOI=	4.35	2.13	6.86	11.19
Sums		PT=	460	260	760	1,040
		BOI=	8.24	4.92	11.33	16.77
Alcids	S	D=	3.06	4.56	6.04	9.14
		PT=	30	40	60	90
		BOI=	1.10	1.77	2.00	2.86
	W	D=	1.12	2.94	34.58	24.05
		PT=	50	130	1,500	1,100
		BOI=	1.92	6.48	49.91	34.07
Sums		PT=	80	170	1,600	1,200
		BOI=	3.02	8.25	51.91	36.93
Summary	S	D=	201.18	24.43	190.83	391.12
		PT=	1,900	230	1,800	3,800
		BOI=	42.14	5.29	35.36	65.08

Table 11. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	W	D=	61.46	5.51	52.30	119.61
		PT=	2,700	240	2,300	5,200
		BOI=	72.28	8.61	62.72	135.11
	Sums	PT=	4,600	470	4,100	9,000
		BOI=	114.42	13.90	98.08	200.99

SUMS = summary
W = water
S = shoreline

Table 12. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Quimper Peninsula Subregion (0312)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	2.00		3.00	3.77
		PT=	20		30	40
		BOI=	0.40		0.53	0.63
Grebes	S	D=	13.50		23.50	37.55
		PT=	140		250	400
		BOI=	2.46		5.89	8.08
Cormorants	S	D=	6.50	10.00	35.00	40.94
		PT=	70	110	380	440
		BOI=	1.53	1.70	8.56	9.66
Ducks and Geese	S	D=	86.00		9.00	175.47
		PT=	920		100	1,900
		BOI=	18.27		2.44	29.87
Sandpipers and other shorebirds	S	D=			25.00	
		PT=			270	
		BOI=			1.23	
Phalaropes	S	D=			25.00	
		PT=			270	
		BOI=			1.78	
Gulls and Terns	S	D=	57.00	32.31	938.00	217.36
		PT=	610	350	10,000	2,300
		BOI=	8.62	6.54	129.00	24.02

Table 12. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Alcids	S	D=	5.00		69.00	10.57
		PT=	50		740	110
		BOI=	2.61		24.09	3.77
Summary	S	D=	170.25	43.85	1152.00	493.77
		PT=	1,800	470	12,000	5,300
		BOI=	33.90	8.25	173.52	76.03

SUMS = summary
W = water
S = shoreline

Table 13. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Whidbey Island Subregion (0313)

			Period			
Family	**Area**		**Spring***	**Summer***	**Fall**	**Winter**
Loons	S	D=			1.57	2.92
		PT=			30	60
		BOI=			0.58	1.32
Grebes	S	D=			23.71	65.25
		PT=			500	1,400
		BOI=			14.31	39.40
Cormorants	S	D=			2.43	2.58
		PT=			50	50
		BOI=			1.14	1.16
Herons	S	D=			0.10	
		PT=			2	
		BOI=			0.01	
Ducks and Geese	S	D=			21.00	24.92
		PT=			440	520
		BOI=			10.31	10.29
Plovers	S	D=				0.17
		PT=				4
		BOI=				0.02
Sandpipers and other shorebirds	S	D=			3.33	
		PT=			70	
		BOI=			0.35	

Table 13. (Continued)

Family	Area		Spring*	Summer*	Fall	Winter
				Period		
Jaegers	S	D=			0.05	
		PT=			1	
		BOI=			<0.01	
Gulls and Terns	S	D=		35.71	11.50	
		PT=			750	240
		BOI=			9.44	3.61
Alcids	S	D=			10.86	3.00
		PT=			230	60
		BOI=			8.17	2.10
Summary	S	D=			115.43	111.17
		PT=			2,400	2,300
		BOI=			44.32	57.90

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 14. *Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Smith Island Subregion (0314)*

			Period			
Family	Area		Spring	Summer	Fall*	Winter
Loons	S	D=				47.27
		PT=				10
		BOI=				0.28
Grebes	S	D=	73.33			30.00
		PT=	20			9
		BOI=	0.36			0.17
Cormorants	S	D=	56.67	73.33		79.09
		PT=	20	20		20
		BOI=	0.38	0.49		0.50
Ducks and Geese	S	D=	1083.33			855.45
		PT=	330			260
		BOI=	9.94			5.84
Plovers	S	D=				0.91
		PT=				<1
		BOI=				<0.01
Sandpipers and other shorebirds	S	D=				6460.91
		PT=				1,900
		BOI=				10.28
Gulls and Terns	S	D=	203.33	1293.33		402.73
		PT=	60	390		120
		BOI=	1.12	7.34		2.15

Table 14. (Continued)

			Period			
Family	Area		Spring	Summer	Fall*	Winter
Alcids	S	D=	20.00	50.00		1.82
		PT=	6	20		1
		BOI=	0.21	0.54		0.02
Summary	S	D=	1436.67	1430.00		7878.18
		PT=	430	430		2,400
		BOI=	12.01	8.37		19.24

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 15. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Deception Pass Subregion (0315)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.15		1.07	4.77
		PT=	6		6	30
		BOI=	0.14		0.12	0.59
Grebes	S	D=	18.23		13.88	17.98
		PT=	100		80	100
		BOI=	2.89		2.06	2.78
Shearwaters	S	D=			0.04	
		PT=			<1	
		BOI=			<0.01	
Cormorants	S	D=	4.19	4.39	14.91	7.27
		PT=	20	30	80	40
		BOI=	0.52	0.55	1.57	0.83
Herons	S	D=			0.11	0.08
		PT=			1	<1
		BOI=			<0.01	<0.01
Ducks and Geese	S	D=	7.29	1.05	5.98	19.87
		PT=	40	6	30	110
		BOI=	0.80	0.11	0.69	2.07
Eagles and Hawks	S	D=	0.06			0.23
		PT=	<1			1
		BOI=	<0.01			0.01

Table 15. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Oystercatchers	S	D=	0.18		0.28	0.08
		PT=	1		2	<1
		BOI=	0.02		0.04	0.01
Plovers	S	D=	0.12			0.03
		PT=	1			<1
		BOI=	<0.01			<0.01
Sandpipers and other shorebirds	S	D=	0.03		1.60	0.08
		PT=	<1		9	<1
		BOI=	<0.01		0.05	<0.01
Jaegers	S	D=			0.07	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	15.31	32.28	77.62	27.75
		PT=	90	180	440	160
		BOI=	1.57	3.42	5.75	2.31
Alcids	S	D=	4.51	26.49	59.61	18.79
		PT=	30	150	330	110
		BOI=	0.98	7.26	10.99	3.57
Summary	S	D=	51.06	64.21	175.16	96.92
		PT=	290	360	980	540
		BOI=	6.93	11.34	21.29	12.17

SUMS = summary
W = water
S = shoreline

Table 16. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Lopez Island Subregion (0316)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Loons	S	D=	0.29		0.93	59.01
		PT=	3		8	530
		BOI=	0.05		0.18	10.57
Grebes	S	D=	0.29			16.20
		PT=	3			140
		BOI=	0.06			2.97
Storm-Petrels	S	D=			4.19	
		PT=			40	
		BOI=			0.32	
Cormorants	S	D=	88.26	140.71	323.02	152.54
		PT=	790	1,300	2,900	1,400
		BOI=	16.25	18.46	61.79	28.61
Herons	S	D=			0.23	0.28
		PT=			2	3
		BOI=			0.01	0.01
Ducks and Geese	S	D=	19.57		6.05	36.62
		PT=	170		50	330
		BOI=	2.57		1.39	5.36
Eagles and Hawks	S	D=	0.72			0.04
		PT=	6			1
		BOI=	0.05			0.01

Table 16. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Oystercatchers	S	D=	1.59		0.93	1.97
		PT=	10		8	20
		BOI=	0.31		0.18	0.39
Sandpipers and other shorebirds	S	D=			0.70	5.21
		PT=			6	50
		BOI=			0.07	0.40
Gulls and Terns	S	D=	896.52	348.46	807.44	408.17
		PT=	8,000	1,200	7,200	3,600
		BOI=	150.45	22.97	122.26	65.66
Alcids	S	D=	40.43	36.15	108.14	29.15
		PT=	360	130	960	260
		BOI=	14.01	6.38	31.38	9.62
Summary	S	D=	1047.83	338.46	1252.33	712.11
		PT=	9,300	1,400	11,000	6,300
		BOI=	183.74	29.56	217.59	123.61

SUMS = summary
W = water
S = shoreline

Table 17. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, San Juan Island (south shore) Subregion (0317)

			Period			
Family	Area		Spring	Summer*	Fall	Winter
Loons	S	D=	22.78		2.43	10.00
		PT=	80		9	40
		BOI=	1.60		0.16	0.70
Grebes	S	D=	2.59		8.11	13.79
		PT=	9		30	50
		BOI=	0.23		0.51	0.90
Storm-Petrels	S	D=			0.14	
		PT=			<1	
		BOI=			<0.01	
Cormorants	S	D=	1.11		95.14	6.03
		PT=	4		330	20
		BOI=	0.09		7.50	0.47
Herons	S	D=	1.11			0.17
		PT=	4			1
		BOI=	0.02			<0.01
Ducks and Geese	S	D=	75.93		26.35	31.55
		PT=	270		90	110
		BOI=	3.26		2.29	1.63
Eagles and Hawks	S	D=	0.19		0.14	1.03
		PT=	1		<1	4
		BOI=	<0.01		<0.01	<0.01

Table 17. (Continued)

Family	Area		Period Spring	Summer*	Fall	Winter
Oystercatchers	S	D=				1.03
		PT=				4
		BOI=				0.08
Plovers	S	D=	24.44		15.41	3.10
		PT=	80		50	10
		BOI=	0.43		0.20	0.06
Sandpipers and other shorebirds	S	D=	33.33		1.62	86.21
		PT=	120		6	300
		BOI=	0.61		0.03	1.59
Jaegers	S	D=			0.14	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	91.85		547.97	320.69
		PT=	320		1,900	1,100
		BOI=	3.96		25.59	12.22
Alcids	S	D=	5.19		85.41	19.48
		PT=	20		300	70
		BOI=	0.85		9.80	2.12
Summary	S	D=	258.52		812.16	498.62
		PT=	910		2,800	1,700
		BOI=	11.45		46.10	19.78

*No data are available.
SUMS = summary, W = water, S = shoreline

Table 18. Seasonal Projections of Density, Numbers, and Importance by Family for the Strait of Juan de Fuca-Inner Region, Victoria, Vancouver Island Subregion (0318)

			Period			
Family	Area		Spring*	Summer*	Fall*	Winter
Grebes	S	D=				5.00
		PT=				40
		BOI=				1.04
Cormorants	S	D=				15.00
		PT=				100
		BOI=				2.36
Ducks and Geese	S	D=				110.00
		PT=				760
		BOI=				10.79
Plovers	S	D=				1.67
		PT=				10
		BOI=				0.06
Gulls and Terns	S	D=				970.00
		PT=				6,700
		BOI=				124.38
Alcids	S	D=				8.33
		PT=				60
		BOI=				1.85
Summary	S	D=				1110.00
		PT=				7,700
		BOI=				140.49

*No data are available. SUMS = summary, W = water, S = shoreline

Section D

Region 4. Admirality Region, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Admiralty Inlet Region, Admiralty Inlet Subregion (0401)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Loons	S	D=	0.23	0.70		1.00
		PT=	4	10		20
		BOI=	0.06	0.18		0.30
	W	D=	0.40			0.45
		PT=	10			11
		BOI=	0.21			0.23
	Sums	PT=	10	10		30
		BOI=	0.27	0.18		0.53
Grebes	S	D=	3.44	1.33		4.06
		PT=	50	20		60
		BOI=	0.97	0.38		1.13
	W	D=	11.98			2.86
		PT=	300			70
		BOI=	5.06			1.33
	Sums	PT=	350	20		130
		BOI=	6.03	0.38		1.46
Cormorants	S	D=	0.62	0.63	0.78	2.13
		PT=	10	10	10	30
		BOI=	0.16	0.22	0.27	0.74
	W	D=	0.40	0.12	0.12	0.66
		PT=	10	3	3	20
		BOI=	0.23	0.07	0.07	0.36

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sums		PT=	20	10	10	50
		BOI=	0.39	0.29	0.34	1.00
Herons	S	D=			0.04	
		PT=			1	
		BOI=			<0.01	
Ducks and Geese	S	D=	3.12		2.93	6.44
		PT=	50		50	100
		BOI=	0.94		1.02	1.90
	W	D=	0.87	0.36	2.38	4.21
		PT=	20	9	60	110
		BOI=	0.46	0.20	0.37	2.98
Sums		PT=	70	9	110	210
		BOI=	1.40	0.20	1.39	4.88
Plovers	S	D=	0.08		0.08	
		PT=	1		1	
		BOI=	0<01		<0.01	
Sandpipers and other shorebirds	S	D=			1.95	
		PT=			30	
		BOI=			0.15	
	W	D=		0.12		
		PT=		3		
		BOI=		0.02		

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	Sums	PT=		3	30	
		BOI=		0.02	0.15	
Phalaropes	S	D=			0.94	
		PT=			10	
		BOI=			0.10	
	W	D=			0.12	
		PT=			3	
		BOI=			0.02	
	Sums	PT=			10	
		BOI=			0.12	
Gulls and Terns	S	D=	56.64	33.13	39.38	17.63
		PT=	880	510	610	270
		BOI=	9.37	8.97	9.21	4.13
	W	D=	22.22	18.04	9.76	24.34
		PT=	560	460	250	620
		BOI=	6.35	8.61	3.90	8.81
	Sums	PT=	1,400	970	860	890
		BOI=	15.72	17.58	13.11	12.94
Alcids	S	D=	3.05	5.00	28.32	46.12
		PT=	50	80	440	710
		BOI=	2.04	3.64	14.39	23.30

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	W	D=	11.43	43.99	1.67	9.15
		PT=	290	1,100	40	230
		BOI=	14.15	56.19	2.01	7.69
	Sums	PT=	340	1,200	480	940
		BOI=	16.19	59.83	16.40	30.99
Summary	S	D=	67.19	38.75	76.48	77.37
		PT=	1,000	600	1,200	1,200
		BOI=	13.52	12.83	25.71	31.50
	W	D=	47.30	62.62	14.05	41.67
		PT=	1,200	1,600	360	1,100
		BOI=	26.46	65.09	6.36	21.38
	Sums	PT=	2,200	2,200	1,600	2,300
		BOI=	39.98	77.92	32.07	52.88

SUMS = summary
W = water
S = shoreline

Section E

Region 5. Anacortes to Hales Passage, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Anacortes to Hales Passage Region, Bellingham Channel Subregion (0501)

Family	Area		Spring	Summer	Fall	Winter
			Period			
Loons	S	D=	1.78	0.91	0.30	2.00
		PT=	8	4	1	9
		BOI=	0.17	0.08	0.03	0.17
	W	D=	15.23	0.45	7.41	11.35
		PT=	1,100	30	510	790
		BOI=	21.48	0.47	10.60	16.40
	Sums	PT=	1,100	30	510	800
		BOI=	21.64	0.06	10.63	16.58
Grebes	S	D=			19.80	53.80
		PT=			90	250
		BOI=			2.45	6.36
	W	D=	9.54		10.69	44.58
		PT=	660		740	3,100
		BOI=	14.89		20.41	88.31
	Sums	PT=	660		830	3,400
		BOI=	14.89		22.86	94.67
Cormorants	S	D=	4.55	13.18	23.20	5.40
		PT=	20	60	110	30
		BOI=	0.48	1.39	2.39	0.50
	W	D=	0.92	0.45	1.38	2.81
		PT=	60	30	100	190
		BOI=	1.41	0.72	2.02	4.25

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sums		PT=	80	90	210	220
		BOI=	1.89	2.11	4.41	4.74
Herons	S	D=	0.10		0.50	1.30
		PT=	<1		2	6
		BOI=	<0.01		0.01	0.03
	W	D=				0.10
		PT=				7
		BOI=				0.04
Sums		PT=	<1		2	10
		BOI=	<0.01		0.01	0.07
Ducks and Geese	S	D=	45.15	14.09	8.80	200.00
		PT=	210	70	40	940
		BOI=	4.04	1.47	0.97	12.13
	W	D=	18.15	5.66[1]	1.72	15.42
		PT=	1,300	390	120	1,100
		BOI=	30.97	9.26	2.83	18.16
Sums		PT=	1,500	460	160	2,000
		BOI=	35.01	10.73	3.80	30.29
Eagles and Hawks	S	D=	0.79		0.30	0.40
		PT=	4		1	2
		BOI=	0.03		0.01	0.01

Table 1. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Oystercatchers	S	D=	0.30			
		PT=	1			
		BOI=	0.31			
Sandpipers and other shorebirds		D=			1.30	2.60
		PT=			6	12
		BOI=			0.06	0.08
Gulls and Terns	S	D=	164.95	473.64	352.30	213.80
		PT=	780	2,200	1,700	1,000
		BOI=	14.49	42.09	24.69	11.97
	W	D=	4.33[2]	2.89[2]	21.90	21.68[2]
		PT=	300	200	1,500	1,500
		BOI=	4.77	3.69	21.71	17.95
Sums		PT=	1,100	2,400	3,200	2,500
		BOI=	19.25	45.78	46.41	29.92
Alcids	S	D=	2.28	8.18	37.90	23.30
		PT=	10	40	180	110
		BOI=	0.40	1.33	6.54	3.76
	W	D=	1.68	4.55	75.57[2]	16.98
		PT=	70	310	5,200	1,200
		BOI=	2.74	14.54	169.16	41.28
Sums		PT=	80	350	5,400	1,300
		BOI=	3.13	15.87	175.70	45.04

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Summary	S	D=	224.65	510.00	451.50	518.80
		PT=	1,100	2,400	2,100	2,400
		BOI=	20.21	46.37	37.14	35.00
	W	D=	56.62	14.45	118.50	
		PT=	3,900	1,000	8,200	7,900
		BOI=	84.00	28.69	395.74	186.39
	Sums	PT=	4,500	3,400	10,000	10,000
		BOI=	104.21	75.06	432.88	221.39

[1] Numbers adjusted to allow for small sample size.

[2] Numbers adjusted for small sample size and occurrence of large numbers in dense flocks (i.e., Western Grebe, Arctic Loon, and Bonaparte Gulls feeding in tide-rips).

SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the Anacortes to Hales Passage Region, Guemes Channel Subregion (0502)

			Period			
Family	Area		Spring	Summer*	Fall*	Winter
Loons	S	D=	2.86			0.71
		PT=	30			7
		BOI=	0.44			0.11
Grebes	S	D=	12.86			27.86
		PT=	130			280
		BOI=	2.30			5.94
Cormorants	S	D=	11.43			7.14
		PT=	120			70
		BOI=	2.63			1.25
Herons	S	D=	2.86			
		PT=	30			
		BOI=	0.15			
Ducks and Geese	S	D=	27.14			34.29
		PT=	280			350
		BOI=	3.76			5.23
Gulls and Terns	S	D=	10.00			62.86
		PT=	102			640
		BOI=	1.70			7.71
Alcids	S	D=	8.52			21.43
		PT=	350			220
		BOI=	13.07			10.56

Table 2. (Continued)

Family	Area	Period Spring	Summer*	Fall*	Winter
Summary	S D=	101.43			154.29
	PT=	1,000			1,600
	BOI=	24.04			30.81

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the Anacortes to Hales Passage Region, Fidalgo Bay Subregion (0503)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.48		0.17	2.24
		PT=	20		2	30
		BOI=	0.33		0.03	0.50
Grebes	S	D=	8.13		20.04	92.54
		PT=	90		230	1,100
		BOI=	2.17		6.10	31.14
Cormorants	S	D=	5.39	12.52	16.83	9.96
		PT=	60	140	190	110
		BOI=	1.05	2.11	3.10	1.77
Herons	S	D=	0.96	2.00	2.54	0.54
		PT-	10	20	30	6
		BOI=	0.06	0.12	0.15	0.03
Ducks and Geese	S	D=	152.26	6.00	28.54	255.07
		PT=	1,800	70	330	2,900
		BOI=	44.78	1.76	4.61	29.43
Eagles and Hawks	S	D=	0.04	0.17		
		PT=	1	2		
		BOI=	<0.01	0.01		
Rails	S	D=	0.35			0.07
		PT=	4			1
		BOI=	0.01			<0.01

Table 3. *(Continued)*

Family	Area		Spring	Summer	Fall	Winter
			Period			
Plovers	S	D=	0.26	0.17	1.39	0.04
		PT=	3	2	16	1
		BOI=	<0.01	<0.01	0.05	<0.01
Sandpipers and other shorebirds	S	D=	0.13		3.09	54.83
		PT=	2		40	630
		BOI=	<0.01		0.18	3.33
Gulls and Terns	S	D=	4.74	11.91	34.43	15.52
		PT=	50	140	400	180
		BOI=	1.03	2.59	4.72	2.62
Alcids	S	D=	0.04	0.43	0.07	0.07
		PT=	1	5	1	1
		BOI=	0.02	0.17	0.04	0.04
Summary	S	D=	173.78	33.82	107.13	430.87
		PT=	2,000	380	1,200	5,000
		BOI=	49.47	6.77	18.97	68.85

SUMS = summary
W = water
S = shoreline

Table 4. Seasonal Projections of Density, Numbers, and Importance by Family for the Anacortes to Hales Passage Region, Padilla Bay Subregion (0504)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.47	0.20	0.19	0.51
		PT=	30	10	10	30
		BOI=	0.41	0.17	0.16	0.51
	W	D=	3.78		4.00	5.23
		PT=	100	*	100	130
		BOI=	1.79		1.76	2.43
	Sums	PT=	130	10	110	160
		BOI=	2.20	0.17	1.92	2.95
Grebes	S	D=	1.80	0.37	4.51	20.71
		PT=	100	20	250	1,100
		BOI=	2.29	0.59	6.74	32.78
	W	D=	11.56		61.20	38.64
		PT=	290	*	1,500	970
		BOI=	7.72		33.91	25.31
	Sums	PT=	390	20	1,800	2,100
		BOI=	10.01	0.59	40.65	58.09
Cormorants	S	D=	1.24	0.61	2.75	2.04
		PT=	70	30	150	110
		BOI=	1.19	0.65	2.32	1.90
	W	D=	1.78			8.18
		PT=	40	*		200
		BOI=	0.97			3.54

Table 4. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sums		PT=	110	30	150	310
		BOI=	2.16	0.65	2.32	5.44
Herons	S	D=	1.88	0.43	1.28	0.16
		PT=	100	20	70	9
		BOI=	0.52	0.12	0.35	0.04
	W	D=	0.67		9.20	
		PT=	20	*	230	
		BOI=	0.08		1.16	
Sums		PT=	120	20	300	9
		BOI=	0.60	0.12	1.51	0.04
Ducks and Geese	S	D=	259.45	22.52	125.19	324.67
		PT=	14,000	1,200	6,900	18,000
		BOI=	426.19	22.53	57.93	294.93
	W	D=	1182.44		551.60	2648.86
		PT=	30,000	*	14,000	66,000
		BOI=	594.31		251.29	1254.43
Sums		PT=	44,000	1,200	21,000	84,000
		BOI=	1020.50	22.53	309.22	1549.36
Eagles and Hawks	S	D=	0.09	0.02	0.01	0.07
		PT=	5	1	1	4
		BOI=	0.04	<0.01	<0.01	0.03
	W	D=				0.23
		PT=		*		5
		BOI=				<0.01

Table 4. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
Sums		PT=	5	1	1	9
		BOI=	0.04	<0.01	<0.01	0.03
Rails	S	D=	0.02			
		PT=	1			
		BOI=	<0.01			
Plovers	S	D=	0.06		0.43	0.00
		PT=	4		20	<1
		BOI=	0.01		0.01	<0.01
Sandpipers and other shorebirds	S	D=	8.21		10.80	18.10
		PT=	450		590	1,000
		BOI=	2.39		3.02	5.27
	W	D=			1.60	
		PT=		*	40	
		BOI=			0.21	
Sums		PT=	450		630	1,000
		BOI=	2.39		3.23	5.27
Gulls and Terns	S	D=	28.99	14.83	23.19	10.99
		PT=	1,600	800	1,300	600
		BOI=	30.03	15.28	19.30	9.66
	W	D=	30.44		383.20	68.86
		PT=	800	*	9,600	1,700
		BOI=	13.49		111.40	27.84

Table 4. *(Continued)*

Family	Area		Period Spring	 Summer	 Fall	 Winter
	Sums	PT=	2,400	800	11,000	2,300
		BOI=	43.52	15.28	130.71	37.51
Alcids	S	D=	0.26	1.12	0.06	0.81
		PT=	10	60	3	40
		BOI=	0.61	2.62	0.13	1.50
	W	D=			3.20	16.59
		PT=		*	80	410
		BOI=			4.35	18.65
	Sums	PT=	10	60	80	450
		BOI=	0.61	2.62	4.48	20.15
Summary	S	D=	290.91	38.18	169.09	381.82
		PT=	16,000	2,100	9,300	21,000
		BOI=	463.68	41.96	89.96	346.63
	W	D=	1240.00		1040.00	2760.00
		PT=	31,000	*	26,000	69,000
		BOI=	618.35		404.09	1332.20
	Sums	PT=	47,000	2,100	35,000	90,000
		BOI=	1082.03	41.96	494.05	1678.83

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 5. Seasonal Projections of Density, Numbers, and Importance by Family for the Anacortes to Hales Passage Region, Samish Bay Subregion (0505)

Family	Area		Period Spring	Summer	Fall	Winter
Loons	S	D=	1.67	0.08	0.71	0.97
		PT=	50	2	20	30
		BOI=	0.84	0.04	0.41	0.54
	W	D=	7.65	1.43	4.12	13.41
		PT=	270	50	150	500
		BOI=	5.21	0.98	3.13	9.98
	Sums	PT=	320	50	170	530
		BOI=	6.04	1.02	3.54	10.52
Grebes	S	D=	56.25		36.85	67.67
		PT=	1,600		1,100	2,000
		BOI=	48.86		31.65	58.20
	W	D=	122.16		202.75	65.45
		PT=	4,300		7,200	2,400
		BOI=	127.80		215.63	47.40
	Sums	PT=	5,900		8,300	4,400
		BOI=	176.65		247.28	106.60
Cormorants	S	D=	1.00	0.31	1.89	1.36
		PT=	30	9	60	40
		BOI=	0.45	0.21	0.93	0.68
	W	D=	0.39		2.94	0.68
		PT=	10		100	30
		BOI=	0.32		2.25	0.55

Table 5. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
Sums		PT=	40	9	160	70
		BOI=	0.77	0.21	3.17	1.23
Herons	S	D=	2.03	7.29	3.41	0.60
		PT=	60	210	100	20
		BOI=	0.30	1.07	0.52	0.09
	W	D=	0.39			
		PT=	10			
		BOI=	0.32			
Sums		PT=	70	210	100	20
		BOI=	0.06	1.07	0.52	0.09
Ducks and Geese	S	D=	401.84	1.35	243.85	332.75
		PT=	1,200	40	7,300	9,600
		BOI=	339.42	0.94	78.51	143.06
	W	D=	459.61	14.29	59.61	1123.18
		PT=	16,000	500	2.100	42,000
		BOI=	331.84	4.25	51.38	501.66
Sums		PT=	17,000	540	9,400	52,000
		BOI=	671.25	5.19	129.89	644.73
Eagles and Hawks	S	D=				0.05
		PT=				1
		BOI=				<0.01

Table 5.   (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	W	D=				0.68[1]
		PT=				1
		BOI=				<0.01
Sums		PT=				2
		BOI=				<0.01
Rails	S	D=	0.02			0.02
		PT=	<1			1
		BOI=	<0.01			<0.01
Sums		PT=	<1			1
		BOI=	<0.01			<0.01
Plovers	S	D=	4.63	0.48	2.97	1.18
		PT=	130	14	90	30
		BOI=	0.66	0.06	0.44	0.17
Sums		PT=	130	14	90	30
		BOI=	0.66	0.06	0.44	0.17
Sandpipers and other shorebirds	S	D=	233.02	112.73	58.38	83.63
		PT=	6,800	3,300	1,100	2,400
		BOI=	35.68	10.99	14.28	12.80
Sums		PT=	6,800	3,300	1,100	2,400
		BOI=	35.68	10.99	14.28	12.81
Gulls and Terns	S	D=	40.08	10.69	35.38	7.36
		PT=	1,200	310	1,100	210
		BOI=	18.80	5.33	14.28	3.22

Table 5. (Continued)

Family	Area		Spring	Summer	Fall	Winter
	W	D=	24.51	2.14	8.63	87.27
		PT=	870	80	300	3,200
		BOI=	15.17	1.43	3.63	41.08
	Sums	PT=	2,100	390	1,400	3,400
		BOI=	33.96	6.76	17.91	44.31
Alcids	S	D=	0.06	0.40	0.35	0.12
		PT=	2	10	10	3
		BOI=	0.08	0.40	0.46	0.18
	W	D=	0.78	1.43	1.18	20.91
		PT=	30	50	40	770
		BOI=	1.35	2.54	2.12	51.77
	Sums	PT=	30	60	50	770
		BOI=	1.43	2.94	2.58	51.95
Summary	S	D=	379.31	134.48	379.31	48.28
		PT=	11,000	3,900	11,000	14,000
		BOI=	445.08	19.04	141.47	218.95
	W	D=	677.42	21.94	319.35	1580.65
		PT=	21,000	680	9,900	49,000
		BOI=	481.99	59.20	278.14	652.44
	Sums	PT=	33,000	4,600	21,000	63,000
		BOI=	927.07	78.24	419.61	871.40

[1] Numbers adjusted to allow for small sample size.
SUMS = summary, W = water, S = shoreline

Table 6. Seasonal Projections of Density, Numbers, and Importance by Family for the Anacortes to Hales Passage Region, Bellingham Bay Subregion (0506)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.81	0.15	0.08	1.26
		PT=	30	6	3	50
		BOI=	0.57	0.08	0.05	0.85
	W	D=	3.70		3.96	6.24
		PT=	450		490	760
		BOI=	9.89		10.42	15.73
	Sums	PT=	480	6	490	810
		BOI=	10.46	0.08	10.46	16.58
Grebes	S	D=	17.99	4.94	45.61	114.44
		PT=	650	200	1,600	4,100
		BOI=	18.94	5.83	48.95	122.83
	W	D=	43.84	3.33	67.03	147.23
		PT=	5,300	410	8,200	18,000
		BOI=	158.17	11.95	244.80	536.29
	Sums	PT=	6,000	610	9,800	22,000
		BOI=	177.11	17.79	293.75	659.12
Cormorants		D=	2.13	0.46	3.07	5.38
		PT=	80	20	110	190
		BOI=	1.54	0.34	2.18	3.79
	W	D=	1.64	0.21	0.54	5.82
		PT=	200	30	70	710
		BOI=	4.27	0.58	1.43	15.52

Table 6. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sums		PT=	280	50	180	900
		BOI=	5.81	0.92	3.61	19.31
Herons		D=	0.70	1.64	0.80	0.42
		PT=	30	60	30	20
		BOI=	0.13	0.30	0.14	0.08
Ducks and Geese	S	D=	33.50	3.11	14.73	67.74
		PT=	1,300	110	530	2,400
		BOI=	21.95	2.17	7.25	27.52
	W	D=	3.97			37.52
		PT=	490			4,600
		BOI=	9.44			91.15
Sums		PT=	1,800	110	530	7,000
		BOI=	31.38	2.17	7.25	118.67
Eagles and Hawks	S	D=	0.23	0.06	0.07	0.20
		PT=	8	2	3	7
		BOI=	0.06	0.02	0.02	0.05
Rails	S	D=	0.02		0.01	0.08
		PT=	1		<1	3
		BOI=	<0.01		<0.01	<0.01
Oystercatchers	S	D=			0.02	
		PT=			1	
		BOI=			0.02	

Table 6. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Plovers	S	D=	0.07	0.19	0.07	0.04
		PT=	3	7	3	1
		BOI=	<0.01	0.02	<0.01	<0.01
Sandpipers and other shorebirds	S	D=	10.77	0.27	11.91	8.63
		PT=	390	10	430	310
		BOI=	2.24	0.05	2.21	1.81
Jaegers	S	D=			0.01	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	26.95	21.91	36.44	24.21
		PT=	970	790	1,300	870
		BOI=	15.14	13.88	18.85	12.65
	W	D=	13.90	4.79	23.60	34.82
		PT=	1,700	580	2,900	4,200
		BOI=	21.41	11.07	44.22	61.44
Sums		PT=	2,700	1,400	4,200	5,100
		BOI=	36.55	24.95	63.07	74.08
Alcids	S	D=	0.71	1.20	0.75	1.12
		PT=	30	40	30	40
		BOI=	1.04	1.49	1.08	2.13
	W	D=	0.21	0.83	50.09	33.83
		PT=	25	100	6,100	4,100
		BOI=	0.98	3.34	207.85	146.85

Table 6. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
	Sums	PT=	50	140	6,100	4,100
		BOI=	2.02	4.83	208.93	148.98
Summary	S	D=	97.22	33.33	111.11	222.22
		PT=	3,500	1,200	4,000	8,000
		BOI=	61.60	24.18	80.74	171.70
	W	D=	67.21	9.01639	147.54	26.23
		PT=	8,200	1,100	18,000	32,000
		BOI=	204.15	26.94	508.71	866.98
	Sums	PT=	12,000	2,300	22,000	40,000
		BOI=	265.75	51.12	589.45	1038.68

SUMS = summary
W = water
S = shoreline

Table 7. Seasonal Projections of Density, Numbers, and Importance by Family for the Anacortes to Hales Passage Region, Hales Passage Subregion (0507)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	2.94	0.50	0.35	5.14
		PT=	50	8	6	80
		BOI=	0.94	0.16	0.09	1.70
Grebes	S	D=	5.21		4.43	17.68
		PT=	80		70	280
		BOI=	2.11		1.82	6.69
Cormorants	S	D=	1.03	0.10	0.39	1.38
		PT=	20	2	6	20
		BOI=	0.28	0.03	0.11	0.37
Herons	S	D=	0.03	0.95	0.08	0.03
		PT=	<1	20	1	<1
		BOI=	<0.01	0.08	<0.01	<0.01
Ducks and Geese	S	D=	18.95	0.85	1.33	31.76
		PT=	300	10	20	510
		BOI=	6.19	0.34	0.42	8.58
Eagles and Hawks	S	D=	0.03		0.04	0.11
		PT=	<1		1	2
		BOI=	<0.01		<0.01	0.01
Sandpipers and other shorebirds	S	D=				6.08
		PT=				100
		BOI=				0.52

Table 7. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Jaegers	S	D=				0.03
		PT=				<1
		BOI=				<0.01
Gulls and Terns	S	D=	96.38	17.75	15.65	10.86
		PT=	1,600	290	250	170
		BOI=	19.58	4.72	3.35	2.61
Alcids	S	D=	1.44	3.55	2.35	4.46
		PT=	20	60	40	70
		BOI=	0.93	2.84	1.58	3.03
Summary	S	D=	126.18	23.70	24.63	77.51
		PT=	2,000	380	400	1,200
		BOI=	30.08	8.17	7.38	23.50

SUMS = summary
W = water
S = shoreline

Section F

Region 6. Georgia Strait--Eastern, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. *Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, Lummi Bay Subregion (0601)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.60	0.10	0.13	1.80
		PT=	10	2	2	30
		BOI=	0.18	0.03	0.03	0.60
	W	D=	226.05[1]		0.91	9.26
		PT=	1,800		7	70
		BOI=	36.44		0.16	1.43
	Sums	PT=	1,800	2	9	100
		BOI=	36.62	0.03	0.19	2.03
Grebes	S	D=	2.27		18.40	3.88
		PT=	40		310	70
		BOI=	0.77		7.69	1.29
	W	D=	6.67		21.36	10.00
		PT=	50		170	80
		BOI=	1.45		3.90	1.97
	Sums	PT=	90		480	150
		BOI=	2.22		11.59	3.26
Cormorants	S	D=	0.97		3.77	2.02
		PT=	20		60	30
		BOI=	0.33		1.18	0.66
	W	D=	0.74	1.11	4.55	7.04
		PT=	6	9	40	60
		BOI=	0.14	0.12	0.54	0.80

Table 1. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
	Sums	PT=	30	9	100	90
		BOI=	0.47	0.12	1.72	1.47
Herons	S	D=	3.13	4.10	7.53	0.84
		PT=	50	70	130	10
		BOI=	0.27	0.35	6.80	0.07
	W	D=	2.96	7.78	9.55	0.74
		PT=	20	60	80	6
		BOI=	0.12	0.31	0.38	0.03
	Sums	PT=	70	130	210	20
		BOI=	0.39	0.66	7.18	0.10
Ducks and Geese	S	D=	1107.33	0.60	196.93	623.52
		PT=	19,000	10	3,300	11,000
		BOI=	462.08	0.17	38.41	117.86
	W	D=	590.74	68.89	20.91	727.78
		PT=	4,700	550	170	5,800
		BOI=	108.82	13.95	3.48	172.37
	Sums	PT=	24,000	560	3,500	17,000
		BOI=	570.90	14.11	41.89	290.23
Eagles and Hawks	S	D=				0.02
		PT=				<1
		BOI=				<0.01

Table 1. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
Plovers	S	D=	3.53	0.65	2.70	1.92
		PT=	60	10	50	30
		BOI=	0.30	0.03	0.18	0.02
Sandpipers and other shorebirds	S	D=	1306.23	159.20	13.30	254.14
		PT=	22,000	2,700	230	4,300
		BOI=	76.28	10.14	0.09	22.80
	W	D=	203.70			
		PT=	1,600			
		BOI=	8.50			
Sums		PT=	24,000	2,700	230	4,300
		BOI=	84.79	10.17	0.28	22.82
Gulls and Terns	S	D=	28.57	29.20	73.23	17.70
		PT=	490	500	1,200	300
		BOI=	7.86	7.25	13.64	4.68
	W	D=	101.85	31.11	69.55	24.07
		PT=	800	250	560	190
		BOI=	14.06	4.71	8.69	3.08
Sums		PT=	1,300	750	1,800	490
		BOI=	21.92	11.97	22.24	7.77
Alcids	S	D=				0.02
		PT=				<1
		BOI=				0.02

Table 1. (Continued)

				Period			
Family		Area		Spring	Summer	Fall	Winter
		W	D=	3.70	1.11	21.82	1.11
			PT=	30	10	170	9
			BOI=	0.97	0.48	6.37	0.42
	Sums		PT=	30	10	170	9
			BOI=	0.97	0.48	6.37	0.44
Summary		S	D=	2346.37	184.36	296.09	893.85
			PT=	42,000	3,300	5,300	16,000
			BOI=	548.08	17.97	68.03	148.00
		W	D=	1125.00	110.00	150.00	775.00
			PT=	9,000	880	1,200	6,200
			BOI=	170.51	19.58	23.43	180.11
	Sums		PT=	51,000	4,200	6,500	22,000
			BOI=	718.58	37.55	91.46	328.11

[1] Numbers adjusted for small sample size and occurrence of large numbers in dense flocks (i.e., Western Grebe, Arctic Loon, and Bonaparte Gulls feeding in tide-rips).

SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, Cherry Point Subregion (0602)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	51.70	0.22	0.38	2.41
		PT=	780	3	5	30
		BOI=	14.67	0.05	0.09	0.64
Grebes	S	D=	6.11	0.27	2.72	8.23
		PT=	90	4	40	120
		BOI=	2.60	0.37	1.01	2.62
Cormorants	S	D=	0.25	1.35	4.03	5.56
		PT=	3	20	60	80
		BOI=	0.07	0.37	1.20	1.60
Herons	S	D=	0.02	0.11		
		PT=	<1	2		
		BOI=	<0.01	<0.01		
Ducks and Geese	S	D=	1534.70	12.12	7.50	77.14
		PT=	22,000	170	110	1,100
		BOI=	549.09	4.16	2.49	18.85
Plovers	S	D=	0.05	0.11	0.08	
		PT=	<1	2	1	
		BOI=	<0.01	<0.01	<0.01	
Sandpipers and other shorebirds	S	D=	0.02	0.36	0.30	8.83
		PT=	<1	5	4	120
		BOI=	<0.01	0.03	0.02	0.68

Table 2. (Continued)

Family	Area		Period Spring	Summer	Fall	Winter
Gulls and Terns	S	D=	91.82	13.98	14.03	21.28
		PT=	1,300	200	200	300
		BOI=	16.25	3.43	2.64	4.85
Alcids	S	D=	0.46	0.41	4.03	0.45
		PT=	6	6	60	6
		BOI=	0.32	0.23	2.21	0.25
Summary	S	D=	1695.67	28.96	33.12	124.02
		PT=	24,000	400	500	1,800
		BOI=	583.00	8.63	9.65	29.50

SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, Birch Bay Subregion (0603)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.80	0.77	4.29	3.52
		PT=	7	7	40	30
		BOI=	0.11	0.10	0.63	0.59
	W	D=	3.08		2.31	4.87
		PT=	30		20	50
		BOI=	0.55		0.38	1.02
	Sums	PT=	40	7	60	80
		BOI=	0.66	0.10	1.00	1.61
Grebes	S	D=	19.80	27.61	85.26	12.92
		PT=	180	250	770	120
		BOI=	5.00	7.50	22.16	3.10
	W	D=	13.85		14.36	30.51
		PT=	140		140	300
		BOI=	3.87		4.01	7.02
	Sums	PT=	320	250	910	420
		BOI=	8.87	7.50	26.17	10.12
Cormorants	S	D=	0.60	0.49	6.40	1.00
		PT=	5	4	60	9
		BOI=	0.84	0.08	1.01	0.17
	W	D=	5.64	0.77	2.31	2.82
		PT=	60	8	20	30
		BOI=	1.22	0.18	0.53	0.60

Table 3. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	Sums	PT=	70	10	80	40
		BOI=	2.06	0.26	1.54	0.77
Herons	S	D=	1.17	3.73	1.77	0.55
		PT=	10	30	20	5
		BOI=	0.05	0.17	0.08	0.02
Ducks and Geese	S	D=	591.14	22.68	440.20	360.96
		PT=	5,300	200	4,000	3,200
		BOI=	132.11	2.23	55.30	50.63
	W	D=	185.38		36.92	130.77
		PT=	1,900		370	1,300
		BOI=	42.29		9.07	29.56
	Sums	PT=	7,200	200	4,400	4,500
		BOI=	174.40	2.23	64.38	80.19
Eagles and Hawks	S	D=		0.07		
		PT=		1		
		BOI=		<0.01		
Plovers	S	D=	0.03	1.27	1.51	0.30
		PT=	<1	10	10	3
		BOI=	<0.01	0.04	0.04	<0.01
Sandpipers and other shorebirds	S	D=	2.57	3.10	8.46	37.24
		PT=	20	30	80	330
		BOI=	0.11	0.12	0.36	1.77

Table 3. (Continued)

Family	Area		Period Spring	Summer	Fall	Winter
Jaegers	S	D=			0.03	
		PT=			<1	
		BOI=			<0.01	
	W	D=			0.51	
		PT=			5	
		BOI=			0.02	
	Sums	PT=			5	
		BOI=			0.02	
Gulls and Terns	S	D=	144.20	43.94	74.57	75.24
		PT=	1,300	400	670	670
		BOI=	16.50	6.73	8.86	10.23
	W	D=	58.21	26.15	46.41	163.85
		PT=	590	260	460	1,600
		BOI=	7.00	4.95	5.99	22.84
	Sums	PT=	1,900	660	1,100	2,300
		BOI=	23.50	11.68	14.84	33.07
Alcids	S	D=	0.11	0.21	0.66	0.24
		PT=	1	2	6	2
		BOI=	0.05	0.08	0.29	0.12
	W	D=	1.54		19.74	12.82
		PT=	20		200	130
		BOI=	0.63		9.05	4.65

Table 3. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	Sums	PT=	20	2	210	130
		BOI=	0.68	0.08	9.34	4.77
Summary	S	D=	755.56	100.00	633.33	491.97
		PT=	6,800	900	5,700	4,400
		BOI=	154.77	17.07	89.22	96.63
	W	D=	270.00	27.00	120.00	780.00
		PT=	2,700	270	1,200	7,800
		BOI=	55.56	5.13	29.05	65.68
	Sums	PT=	9,500	1,200	6,900	12,000
		BOI=	210.33	22.19	118.27	162.31

SUMS = summary
W = water
S = shoreline

Table 4. Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, Semiahmoo Spit Subregion (0604)

				Period		
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.90	1.75	2.21	5.39
		PT=	9	20	20	50
		BOI=	0.15	0.25	0.31	0.91
Grebes	S	D=	3.08	0.75	659.53	41.76
		PT=	30	7	6,300	400
		BOI=	0.66	0.22	188.49	7.28
Cormorants	S	D=	1.83	4.25	12.91	6.37
		PT=	20	40	120	60
		BOI=	0.38	0.92	2.39	1.27
Herons	S	D=	0.87	5.50	8.26	0.10
		PT=	8	50	80	1
		BOI=	0.04	0.26	0.40	<0.01
Ducks and Geese	S	D=	914.33	68.75	275.00	813.73
		PT=	8,700	700	2,600	7,700
		BOI=	193.06	14.15	60.66	143.92
Sandpipers and other shorebirds	S	D=		2.00		297.55[1]
		PT=		20		2,800
		BOI=		0.11		14.93
Gulls and Terns	S	D=	226.15	76.50	70.70	63.53
		PT=	2,100	700	670	600
		BOI=	25.98	13.26	9.74	9.11

Table 4. (Continued)

Family	Area		Spring	Summer	Fall	Winter
			Period			
Alcids	S	D=		1.50	0.70	5.10
		PT=		10	7	50
		BOI=		0.72	0.36	1.67
Summary	S	D=				
		PT=	11,000	1,500	9,800	12,000
		BOI=	220.27	29.89	262.35	179.09

[1] Numbers adjusted for small sample size and occurrence of large numbers in dense flocks (i.e., Western Grebe, Arctic Loon, and Bonaparte's Gulls feeding in tiderips).

SUMS = summary
W = water
S = shoreline

Table 5. Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, Drayton Harbor Subregion (0605)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	2.33	0.93	3.86	9.21
		PT=	30	10	50	120
		BOI=	0.46	0.18	0.77	2.34
Grebes	S	D=	27.92	0.58	33.23	36.39
		PT=	360	7	430	470
		BOI=	8.76	0.22	11.33	12.24
Cormorants	S	D=	3.77	4.26	6.36	6.62
		PT=	50	50	80	80
		BOI=	0.81	0.88	1.37	1.56
Herons	S	D=	3.00	13.06	4.63	1.06
		PT=	40	170	60	10
		BOI=	0.19	0.84	0.30	0.07
Ducks and Geese	S	D=	142.97	55.35	421.31	638.36
		PT=	1,800	700	5,300	8,200
		BOI=	40.57	14.49	50.15	88.92
Eagles and Hawks	S	D=		0.04		0.03
		PT=		<1		<1
		BOI=		<0.01		<0.01
Rails	S	D=	0.59	0.08	0.16	1.34
		PT=	8	1	2	20
		BOI=	0.02	<0.01	<0.01	0.05

Table 5. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Plovers	S	D=	0.46	2.75	1.75	0.03
		PT=	5	35	22	<1
		BOI=	0.02	0.11	0.07	<0.01
Sandpipers and other shorebirds	S	D=	133.54	60.31	7.00	53.00
		PT=	1,700	770	90	690
		BOI=	9.42	4.40	0.45	3.64
Gulls and Terns	S	D=	40.31	61.55	97.41	64.13
		PT=	520	790	1,200	820
		BOI=	7.02	11.93	13.45	10.67
Alcids	S	D=	0.46			0.30
		PT=	6			4
		BOI=	0.29			0.18
Summary	S	D=				
		PT=	4,500	2,500	7,400	10,000
		BOI=	67.55	33.05	77.90	119.67

SUMS = summary
W = water
S = shoreline

Table 6. Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, Boundary Bay Subregion (0606)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=	8.42	1.05	0.79	17.37[1]
		PT=	1,300	160	120	2,600
		BOI=	25.55	2.38	1.96	59.76
Grebes	W	D=	27.89		57.11	172.16[1]
		PT=	4,200		8,600	26,000[1]
		BOI=	102.24		254.89	773.46
	W	D=	0.53			1.23[1]
		PT=	80			190
		BOI=	1.18			4.03
Ducks and Geese	W	D=	69.65	16.32	56.05	282.11
		PT=	11,000	2,500	8,500	43,000
		BOI=	117.67	60.59	207.17	720.28
Sandpipers and other shorebirds	W	D=			1.32	
		PT=			200	
		BOI=			0.92	
Gulls and Terns	W	D=	13.68	23.16	11.84	104.04
		PT=	2,100	3,500	1,800	16,000
		BOI=	38.36	58.75	24.72	243.37
Alcids	W	D=	0.35	1.05	15.79	40.23[1]
		PT=	53	160	2,400	6,100
		BOI=	2.88	5.12	95.51	199.46

Table 6. *(Continued)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Summary	W	D=	120.70	41.58	156.32	1146.34
		PT=	19,000	6,300	24,000	94,000
		BOI=	287.89	126.84	585.17	2000.63

[1] Numbers adjusted for small sample size and occurrence of large numbers in dense flocks (i.e., Western Grebe, Arctic Loon, and Bonaparte's Gulls feeding in tide-rips).

SUMS = summary
W = water
S = shoreline

Table 7. Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, San Juan Islands Northern Pier Subregion (0607)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.25		10.86	14.43
		PT=	1		50	70
		BOI=	0.02		1.09	1.45
	W	D=	28.89			1.33
		PT=	850			40
		BOI=	17.10			0.67
	Sums	PT=	850		50	110
		BOI=	17.12		1.09	2.13
Grebes	S	D=	1.98		15.93	10.00
		PT=	10		80	50
		BOI=	0.26		1.53	1.11
	W	D=				2.67
		PT=				80
		BOI=				2.08
	Sums	PT=	10		80	130
		BOI=	0.26		1.53	3.19
Cormorants	S	D=	6.17	5.78	43.21	27.08
		PT=	30	30	220	140
		BOI=	0.66	0.65	4.75	3.08
	W	D=	1.11			
		PT=	30			
		BOI=	0.75			

Table 7. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sums		PT=		30	220	140
		BOI=		0.65	4.75	3.08
Herons	S	D=		0.22	0.62	0.19
		PT=		1	3	1
		BOI=		<0.01	<0.02	<0.01
Ducks and Geese	S	D=	19.63	2.11	2.96	69.81
		PT=	100	10	10	350
		BOI=	1.78	0.20	0.35	7.32
	W	D=				4.67
		PT=				140
		BOI=				1.85
Sums		PT=	100	10	10	490
		BOI=	1.78	0.20	0.35	9.17
Eagles and Hawks	S	D=	0.86	0.78	0.25	1.42
		PT=	4	4	1	7
		BOI=	0.03	0.03	<0.01	0.05
Oystercatchers	S	D=	0.49			0.38
		PT=	2			2
		BOI=	0.05			0.04
Sandpipers and other shorebirds	S	D=	4.94		1.98	1.89
		PT=	20		10	10
		BOI=	0.12		0.12	0.11

Table 7. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Jaegers	S	D=			0.12	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	108.77	39.11	338.89	130.75
		PT=	540	200	1,700	650
		BOI=	8.25	3.70	23.67	9.45
	W	D=	80.00	2.00	5.56	165.33
		PT=	2,400	60	160	4,900
		BOI=	30.98	1.11	2.45	50.85
Sums		PT=	3,000	260	1,900	5,600
		BOI=	39.24	4.81	26.12	60.31
Alcids	S	D=	7.16	19.56	72.72	32.55
		PT=	40	100	360	160
		BOI=	1.23	3.50	11.76	5.96
	W	D=	6.67	4.00	28.89	178.00
		PT=	200	120	850	5,200
		BOI=	6.40	4.06	27,47	177.56
Sums		PT=	240	220	1,100	5,400
		BOI=	7.63	7.56	39.24	183.52
Summary	S	D=	151.73	67.56	501.48	289.62
		PT=	760	340	2,500	1,400
		BOI=	12.42	8.08	43.30	28.58

Table 7. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
	W	D=	116.67	6.00	34.44	352.00
		PT=	3,400	180	1,000	10,000
		BOI-	55.23	5.18	29.93	233.02
	Sums	PT=	4,200	520	3,400	11,000
		BOI=	67.65	13.25	73.21	261.60

SUMS = summary
W = water
S = shoreline

Table 8. Seasonal Projections of Density, Numbers, and Importance by Family for the Eastern Georgia Strait Region, Georgia Strait Open Waters Subregion (0608)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=	17.23[1]		1.08[1]	7.05[1]
		PT=	5,000		300	2,000
		BOI=	100.16		6.24	41.00
Grebes	W	D=	2.77[1]		0.46[1]	2.21[1]
		PT=	660		130	640
		BOI=	19.87		2.77	19.22
Cormorants	W	D=	1.00[1]		1.00[1]	1.76[1]
		PT=	290		290	500
		BOI=	6.37		5.98	11.62
Ducks and Geese	W	D=	8.69[1]		0.69[1]	8.38[1]
		PT=	2,500		200	2,400
		BOI=	51.23		4.52	52.50
Gulls and Terns	W	D=	7.41[1]	6.16[1]	29.21[1]	16.66[1]
		PT=	2,100	1,800	8,400	4,800
		BOI=	36.37	33.64	108.80	68.75
Alcids	W	D=	6.97[1]	3.08[1]	26.82[1]	36.68[1]
		PT=	2,000	890	7,700	11,000
		BOI=	66.84	29.00	251.81	345.24
Summary	W	D=	45.09	9.37	58.97	72.84
		PT=	13,000	2,700	17,000	21,000
		BOI=	280.84	62.64	380.12	538.33

[1] Numbers adjusted to allow for small sample size.
SUMS = summary, W = water, S = shoreline

Section G

Region 7. Georgia Strait--Western, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Western Georgia Strait Region, Point Roberts Subregion (0701)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	5.07		3.03	4.33
		PT=	80		50	70
		BOI=	1.57		0.88	1.34
Grebes	S	D=	31.40	1.94	12.11	105.62
		PT=	510	30	200	1,700
		BOI=	14.57	0.81	5.12	49.68
Cormorants	S	D=	5.40	4.84	1.61	8.90
		PT=	90	80	30	150
		BOI=	1.92	1.18	0.51	2.85
Herons	S	D=		1.61	0.19	0.14
		PT=		30	3	2
		BOI=		0.13	0.02	0.01
Ducks and Geese	S	D=	320.37	14.19	28.24	476.33
		PT=	5,200	230	460	7,800
		BOI=	115.38	5.60	9.15	126.43
Plovers	S	D=	0.23	0.32	0.27	
		PT=	4	5	4	
		BOI=	0.01	0.02	0.01	
Sandpipers and other shorebirds	S	D=	7.26		0.34	1.57
		PT=	120		6	30
		BOI=	0.71		0.03	0.13

Table 1. (Continued)

Family	Area	Period Spring	 Summer	 Fall	 Winter
Jaegers	S D=			0.19	
	PT=			3	
	BOI=			<0.01	
Gulls and Terns	S D=	70.42	111.61	83.41	129.19
	PT=	1,100	1,800	1,400	2,100
	BOI=	18.68	34.23	18.61	33.48
Alcids	S D=	48.28	4.19	3.26	23.76
	PT=	790	70	50	390
	BOI=	25.96	3.03	1.91	14.75
Summary	S D=	489.12	138.71	133.26	751.81
	PT=	8,000	2,300	2,200	12,000
	BOI=	178.81	45.00	36.25	228.67

SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the Western Georgia Strait Region, Tsawwassen Bay Subregion (0702)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	14.74		0.83	7.89
		PT=	90		5	50
		BOI=	1.34		0.08	0.75
Grebes	S	D=	8.95		53.33	73.16
		PT=	50		330	450
		BOI=	0.94		7.49	7.66
Cormorants	S	D=	10.00	9.23	7.50	34.74
		PT=	60	60	50	210
		BOI=	1.39	1.29	1.05	4.49
Herons	S	D=	3.16			1.58
		PT=	20			10
		BOI=	0.10			0.05
Ducks and Geese	S	D=	5648.42	5.38	46.67	1093.68
		PT=	35,000	30	280	6,700
		BOI=	750.81	0.84	6.98	84.55
Jaegers	S	D=			3.33	
		PT=			20	
		BOI=			0.04	
Gulls and Terns	S	D=	1491.58	218.46	1159.17	269.47
		PT=	9,100	1,300	7,100	1,600
		BOI=	107.83	25.23	102.71	21.64

Table 2. (Continued)

		Period			
Family	Area	Spring	Summer	Fall	Winter
Summary	S D=	7162.84	233.08	1270.83	1480.53
	PT=	44,000	1,400	7,800	9,000
	BOI=	862.41	27.36	118.33	119.14

SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the Western Georgia Strait Region, Georgia Strait Open Waters Subregion (0703)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=	0.70		0.06	0.14
		PT=	250		20	50
		BOI=	5.22		0.45	1.09
Grebes	W	D=	2.03		0.42	0.09
		PT=	740		150	30
		BOI=	22.35		4.54	1.02
Cormorants	W	D=	0.33		0.03	0.03
		PT=	120		10	10
		BOI=	1.83		0.23	0.18
Herons	W	D=		0.05		
		PT=		20		
		BOI=		0.09		
Ducks and Geese	W	D=	0.57	0.05	0.20	0.17
		PT=	210	20	70	60
		BOI=	5.41	0.48	1.70	1.07
Jaegers	W	D=			0.04	
		PT=			10	
		BOI=			0.03	
Gulls and Terns	W	D=	3.59	1.48	2.03	4.18
		PT=	1,300	500	740	1,500
		BOI=	19.56	10.23	7.72	21.58

Table 3. *(Continued)*

Family	Area		Period			
			Spring	Summer	Fall	Winter
Alcids	W	D=	0.71	0.05	0.11	1.36
		PT=	260	20	40	490
		BOI=	8.26	0.94	1.38	18.59
Summary	W	D=	8.03	1.63	2.89	5.97
		PT=	2,900	600	1,100	2,100
		BOI=	62.63	11.74	16.05	43.51

SUMS = summary
W = water
S = shoreline

Section H

Region 8. Haro Strait region, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Haro Strait Region, Northern Subregion (0801)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	3.89	1.25	9.44	9.14
		PT=	40	10	90	90
		BOI=	0.72	0.18	1.80	1.73
	W	D=				2.86
		PT=				940
		BOI=				18.96
	Sums	PT=	40	10	90	1,000
		BOI=	0.72	0.18	1.80	20.69
Grebes	S	D=	2.56		15.06	22.90
		PT=	20		140	220
		BOI=	0.52		3.31	4.52
	W	D=		1.58	0.83[1]	
		PT=		520	270	
		BOI=		15.71	8.29	
	Sums	PT=	20	520	410	220
		BOI=	0.52	15.71	11.60	4.52
Cormorants	S	D=	7.33	66.87	52.02	23.12
		PT=	70	640	500	220
		BOI=	1.42	14.59	10.65	5.01
	W	D=		1.05	1.67	1.43
		PT=		350	550	470
		BOI=		7.92	12.53	10.74

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sums		PT=	70	990	1,100	690
		BOI=	1.41	22.50	23.19	15.75
Herons	S	D=	0.11		0.22	0.32
		PT=	1		2	3
		BOI=	<0.01		0.01	0.02
Ducks and Geese	S	D=	42.00	31.87	22.36	184.30
		PT=	400	300	210	1,800
		BOI=	6.43	7.35	5.19	24.07
	W	D=	1.67			
		PT=	550			
		BOI=	13.00			
Sums		PT=	950	300	210	1,800
		BOI=	19.43	7.35	5.19	24.07
Eagles and Hawks	S	D=	0.67		0.11	0.54
		PT=	6		1	5
		BOI=	0.05		<0.01	0.04
Oystercatchers	S	D=			0.22	
		PT=			2	
		BOI=			0.05	
Sandpipers and other shorebirds	S	D=	0.22		0.11	5.38
		PT=	2		1	50
		BOI=	<0.01		0.01	0.55

Table 1. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
	W	D=				0.07[1]
		PT=				20
		BOI=				0.25
	Sums	PT=	2		1	70
		BOI=	<0.01		0.01	0.79
Gulls and Terns	S	D=	118.56	137.19	299.66	59.78
		PT=	1,100	1,300	2,900	570
		BOI=	21.37	24.80	37.14	9.04
	W	D=	1.67	3.68	8.00[1]	15.00
		PT=	550	1,200	2,600	4,900
		BOI=	10.38	22.95	24.31	74.88
	Sums	PT=	1,700	2,500	5,500	5,500
		BOI=	31.75	47.75	61.44	83.92
Alcids	S	D=	2.44	11.56	44.94	7.42
		PT=	20	110	430	70
		BOI=	0.87	3.90	13.98	2.81
	W	D=		0.53		4.29
		PT=		170		1,400
		BOI=		5.99		53.41
	Sums	PT=	20	280	430	1,500
		BOI=	0.87	9.88	13.98	56.22

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Summary	S	D=	179.67	249.69	450.79	320.86
		PT=	1,700	2,400	4,300	3,000
		BOI=	31.38	50.81	72.13	47.78
	W	D=	3.33	6.84	10.33	24.29
		PT=	1,100	2,300	3,400	8,000
		BOI=	23.39	52.57	45.13	160.47
	Sums	PT=	2,800	4,600	7,700	11,000
		BOI=	54.77	103.38	117.26	208.25

[1] Numbers adjusted to allow for small sample size.

SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the Haro Strait Region, Southern Subregion (0802)

Family	Area		Period Spring	Summer	Fall	Winter
Loons	S	D=	0.18		8.70	3.06
		PT=	<1		40	20
		BOI=	0.02		0.87	0.31
	W	D=	0.03		0.28	3.39
		PT=	7		60	740
		BOI=	0.15		1.24	15.08
	Sums	PT=	7		100	760
		BOI=	0.17		2.11	16.08
Grebes	S	D=	4.13		3.22	3.41
		PT=	20		20	20
		BOI=	0.59		0.41	0.30
	W	D=	0.48		0.09	0.81
		PT=	100		20	180
		BOI=	3.05		0.61	5.32
	Sums	PT=	120		40	200
		BOI=	3.64		1.02	5.63
Cormorants	S	D=	1.10	2.90	4.18	3.76
		PT=	6	10	20	20
		BOI=	0.12	0.30	0.42	0.35
	W	D=	0.68	0.56	1.27	0.29
		PT=	150	120	280	60
		BOI=	2.26	1.68	5.31	1.44

Table 2. (Continued)

Family	Area		Period Spring	Summer	Fall	Winter
Sums		PT=	160	130	300	80
		BOI=	2.39	1.99	5.73	1.78
Herons	S	D=			0.41	0.94
		PT=			2	5
		BOI=			0.01	0.02
Ducks and Geese	S	D=	5.96	7.10	0.75	28.82
		PT=	30	40	4	140
		BOI=	0.44	0.66	0.06	2.18
	W	D=	0.75		0.05	1.04
		PT=	160		10	230
		BOI=	5.36		0.13	4.80
Sums		PT=	190	40	10	370
		BOI=	5.80	0.66	0.19	6.98
Eagles and Hawks	S	D=	0.09	1.29		0.24
		PT=	<1	6		1
		BOI=	<0.01	0.05		<0.01
	W	D=	0.00	0.02[1]		
		PT=	1	<1		
		BOI=	<0.01	<0.01		
Sums		PT=	1	6		1
		BOI=	<0.01	0.05		<0.01

Table 2. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sandpipers and other shorebirds	S	D=			0.07	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	38.17	24.84	278.42	76.35
		PT=	190	120	1,400	380
		BOI=	2.41	2.31	17.18	6.02
	W	D=	2.07	0.49	1.54	5.17
		PT=	460	110	340	1,100
		BOI=	6.32	2.02	5.13	16.69
Sums		PT=	650	230	1,700	1,500
		BOI=	8.73	4.33	22.32	22.71
Alcids	S	D=	1.01	3.23	49.79	6.35
		PT=	5	20	250	30
		BOI=	0.17	0.56	17.18	1.24
	W	D=	0.78	0.56	1.13	2.03
		PT=	170	120	250	450
		BOI=	6.01	5.42	9.23	14.58
Sums		PT=	180	240	500	480
		BOI=	6.18	5.98	26.42	15.82
Summary	S	D=	50.73	39.35	346.16	126.74
		PT=	250	200	1,700	630
		BOI=	3.75	3.87	27.04	10.45

Table 2. (Continued)

Family	Area		Period Spring	Summer	Fall	Winter
	W	D=	4.83		4.38	12.75
		PT=	1,100	350	1,000	2,800
		BOI=	23.20	9.12	21.66	57.91
	Sums	PT=	1,400	550	2,700	3,400
		BOI=	26.96	13.00	57.79	68.36

[1] Numbers adjusted to allow for small sample size.

SUMS = summary

W = water

S = shoreline

Section I

Region 9. Rosario Strait region, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Rosario Strait Region, Southern Subregion (0901)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.18		1.87	1.89
		PT=	2		20	20
		BOI=	0.04		0.39	0.41
	W	D=	0.37		0.08	6.18
		PT=	40		8	690
		BOI=	0.83		0.16	14.09
	Sums	PT=	40		30	710
		BOI=	0.86		0.54	14.51
Grebes	S	D=	2.89		44.96	7.42
		PT=	30		490	80
		BOI=	0.73		13.74	1.48
	W	D=	0.20		0.17	0.32
		PT=	20		20	40
		BOI=	0.43		0.50	0.74
	Sums	PT=	50		510	120
		BOI=	1.15		14.24	2.21
Cormorants	S	D=	8.21	16.41	58.70	28.22
		PT=	90	180	660	300
		BOI=	1.76	2.91	13.91	6.30
	W	D=	0.55	0.98	5.04	5.95
		PT=	60	110	570	670
		BOI=	1.33	1.76	10.14	13.54

Table 1. (Continued)

Family	Area		Spring	Summer	Fall	Winter
			Period			
	Sums	PT=	150	290	1,200	970
		BOI=	3.08	4.68	24.04	19.84
Herons	S	D=		0.10	0.26	0.04
		PT=		1	3	<1
		BOI=		<0.01	0.01	<0.01
	W	D=		0.03	0.03	
		PT=		3	3	
		BOI=		0.02	0.02	
	Sums	PT=		4	6	<1
		BOI=		0.02	0.03	<0.01
Ducks and Geese	S	D=	3.95	0.29	30.22	21.57
		PT=	40	3	330	230
		BOI=	0.95	0.08	5.40	4.26
	W	D=	1.81	0.03	0.45	1.29
		PT=	200	3	50	150
		BOI=	3.01	0.06	1.21	2.54
	Sums	PT=	240	6	380	380
		BOI=	3.96	0.14	6.61	6.80
Eagles and Hawks	S	D=	0.04		0.04	0.07
		PT-	<1		<1	<1
		BOI=	<0.01		<0.01	<0.01

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	W	D=				0.01
		PT=				1
		BOI=				<0.01
Sums		PT=	<1		<1	1
		BOI=	<0.01		<0.01	<0.01
Oystercatchers	S	D=	0.09		0.35	0.15
		PT=	<1		4	2
		BOI=	0.02		0.08	0.03
	W	D=			0.06	
		PT=			7	
		BOI=			0.15	
Sums		PT=	<1		10	2
		BOI=	0.02		0.24	0.03
Plovers	S	D=				0.04
		PT=				<1
		BOI=				<0.01
Sandpipers and other shorebirds	S	D=	0.18		1.91	2.80
		PT=	2		20	30
		BOI=	<0.01		0.24	0.33
	W	D=			0.02	0.01
		PT=			2	1
		BOI=			<0.01	0.01

Table 1. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sums		PT=	2		20	30
		BOI=	<0.01		0.24	0.35
Phalaropes	W	D=	0.27		0.26	
		PT=	30		30	
		BOI=	0.21		0.20	
Jaegers	S	D=			0.09	
		PT=			<1	
		BOI=			<0.01	
	W	D=			0.03	
		PT=			3	
		BOI=			<0.01	
Sums		PT=			3	
		BOI=			<0.01	
Gulls and Terns	S	D=	72.85	103.88	180.57	46.95
		PT=	790	1,100	2,000	500
		BOI=	14.15	20.55	30.37	8.82
	W	D=	2.25	5.12	35.82	18.60
		PT=	250	580	4,000	2,100
		BOI=	4.21	7.68	52.71	25.63
Sums		PT=	1,000	1,700	6,000	2,600
		BOI=	18.35	28.22	83.07	34.45

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Alcids	S	D=	6.67	13.11	99.91	98.44
		PT=	70	140	1,100	1,100
		BOI=	3.20	7.23	37.73	34.86
	W	D=	1.63	0.87	31.31	49.23
		PT=	180	100	3,500	5,500
		BOI=	7.43	4.80	117.36	179.16
	Sums	PT=	250	240	4,600	6,600
		BOI=	10.63	12.10	155.09	214.03
Summary	S	D=	95.41	134.17	421.22	211.78
		PT=	1,000	1,400	4,600	2,300
		BOI=	20.85	30.77	101.87	56.51
	W	D=	7.11	7.02	73.62	81.66
		PT=	800	800	8,300	9,200
		BOI=	17.43	14.32	182.57	235.72
	Sums	PT=	1,800	2,200	13,000	12,000
		BOI=	38.28	45.09	284.44	292.23

SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the Rosario Strait Region, Central Subregion (0902)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	2.19		0.94	1.67
		PT=	8		3	6
		BOI=	0.16		0.07	0.13
	W	D=			3.75	3.80
		PT=			300	300
		BOI=			6.00	6.09
	Sums	PT=	8		3	6
		BOI=	0.16		0.61	6.62
Grebes	S	D=	0.29		9.62	26.87
		PT=	1		40	100
		BOI=	0.02		0.95	2.69
	W	D=	1.00		26.26	6.40
		PT=	80		2,100	510
		BOI=	2.40		61.53	14.01
	Sums	PT=	80		2,100	610
		BOI=	2.42		62.57	16.70
Cormorants	S	D=	2.48	9.17	22.36	11.60
		PT=	10	30	80	40
		BOI=	0.21	0.50	1.63	0.93
	W	D=	1.33		3.75	2.80
		PT=	110		300	220
		BOI=	2.36		6.80	4.93

Table 2. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sums		PT=	120	30	380	260
		BOI=	2.56	0.50	8.44	5.86
Herons	S	D=			0.19	0.21
		PT=			<1	<1
		BOI=			<0.01	<0.01
	W	D=		0.01		
		PT=		<1		
		BOI=		<0.01		
Sums		PT=		<1	<1	<1
		BOI=		<0.01	<0.01	<0.01
Ducks and Geese	S	D=	8.38	1.67	8.21	20.42
		PT=	30	6	30	80
		BOI=	0.42	0.13	0.47	1.14
	W	D=	2.33		9.38	1.60
		PT=	190		740	130
		BOI=	4.44		14.23	1.52
Sums		PT=	220	6	770	210
		BOI=	4.87	0.13	14.70	2.66
Eagles and Hawks	S	D=	1.33	0.42	0.09	0.83
		PT=	5	2	<1	3
		BOI=	0.04	0.01	<0.01	0.02

Table 2. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Oystercatchers	S	D=				1.81
		PT=				7
		BOI=				0.15
Plovers	S	D=				2.22
		PT=				8
		BOI=				0.04
Sandpipers and other shorebirds	S	D=	1.14		1.23	5.35
		PT=	4		5	20
		BOI=	0.05		0.04	0.13
Jaegers	S	D=			0.75	
		PT=			3	
		BOI=			<0.01	
Gulls and Terns	S	D=	99.81	170.42	500.57	276.87
		PT=	370	630	1,900	1,000
		BOI=	6.64	11.79	20.92	11.92
	W	D=	5.33	1.43	32.63[1]	39.60
		PT=	420	110	2,600	3,100
		BOI=	8.02	2.15	32.18	46.79
Sums		PT=	790	740	4,500	4,100
		BOI=	14.65	13.90	53.10	58.71
Alcids	S	D=	0.95	0.83	111.70	7.50
		PT=	4	3	410	30
		BOI=	0.15	0.11	14.34	1.22

Table 2. *(Continued)*

Family	Area		Spring	Summer	Fall	Winter
	W	D=	2.00		103.75	23.00
		PT=	160		8,200	1,800
		BOI=	6.62		265.75	60.05
	Sums	PT=	160	3	8,600	1,800
		BOI=	6.77	0.11	410.09	61.27
Summary	S	D=	117.14			
		PT=	430	680	2,500	1,300
		BOI=	7.68	12.53	38.42	18.38
	W	D=	12.00			77.80
		PT=	950	110	14,000	6,200
		BOI=	23.84	2.15	386.59	133.38
	Sums	PT=	1,400	780	16,000	8,700
		BOI=	31.52	14.68	425.01	151.76

[1] Numbers adjusted to allow for small sample size.

SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the Rosario Strait Region, Northern Subregion (0903)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	1.67	0.27	0.31	4.10
		PT=	6	<1	1	10
		BOI=	0.10	0.02	0.02	0.27
	W	D=	18.54	0.21	1.00	0.35
		PT=	1,700	20	90	30
		BOI=	33.29	0.38	1.79	0.66
	Sums	PT=	1,700	20	90	40
		BOI=	33.39	0.40	1.81	0.94
Grebes	S	D=	1.25		18.75	48.92
		PT=	4		60	160
		BOI=	0.09		1.67	4.55
	W	D=	3.75		4.75	3.06
		PT=	330		420	270
		BOI=	10.08		12.77	7.48
	Sums	PT=	330		480	430
		BOI=	10.17		14.45	12.03
Cormorants	S	D=	6.04	5.89	3.23	7.35
		PT=	20	20	10	20
		BOI=	0.45	0.36	0.24	0.53
	W	D=	0.42			2.59
		PT=	40			230
		BOI=	0.85			4.12

Table 3. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sums		PT=	60	20	10	250
		BOI=	1.29	0.36	0.24	4.65
Herons	S	D=		0.27	0.42	0.36
		PT=		<1	1	1
		BOI=		<0.01	<0.01	<0.01
Ducks and Geese	S	D=	221.77	0.82	1.67	48.07
		PT=	730	3	6	160
		BOI=	13.45	0.05	0.13	2.27
	W	D=	27.29		0.25	1.88
		PT=	2,400		20	170
		BOI=	58.82		0.57	3.87
Sums		PT=	3,100	3	30	330
		BOI=	73.28	0.05	0.70	6.14
Eagles and Hawks	S	D=	0.62	0.41	0.10	1.33
		PT=	2	1	<1	4
		BOI=	0.01	<0.01	<0.01	0.03
Plovers	S	D=			0.62	
		PT=			2	
		BOI=			<0.01	
Sandpipers and other shorebirds	S	D=			0.10	1.45
		PT=			<1	5
		BOI=			<0.01	0.05

Table 3. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	W	D=				1.18
		PT=				100
		BOI=				0.74
	Sums	PT=			<1	5
		BOI=			<0.01	0.79
Jaegers	W	D=			0.25	
		PT=			20	
		BOI=			0.04	
Gulls and Terns	S	D=	221.46	131.64	240.52	50.48
		PT=	730	430	790	170
		BOI=	11.33	8.02	9.46	2.46
	W	D=	23.96	14.04	52.25	32.35
		PT=	2,100	1,200	4,600	2,900
		BOI=	23.73	23.63	58.76	52.00
	Sums	PT=	2,800	1,600	5,400	3,100
		BOI=	35.06	31.65	68.22	54.46
Alcids	S	D=	1.98	8.90	17.81	8.67
		PT=	7	30	60	30
		BOI=	0.30	1.22	1.98	1.05
	W	D=	0.42	1.06	117.50	33.18
		PT=	40	90	10,000	2,900
		BOI=	1.28	4.92	339.81	95.73

Table 3. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	Sums	PT=	50	120	10,000	2,900
		BOI=	1.58	6.14	341.78	96.79
Summary	S	D=	455.31	148.22	288.44	179.04
		PT=	1,500	490	930	590
		BOI=	25.74	9.68	13.53	11.22
	W	D=	74.37	15.32	178.25	74.71
		PT=	6,600	1,400	16,000	6,600
		BOI=	128.05	28.93	413.74	164.62
	Sums	PT=	8,100	1,900	17,000	7,200
		BOI=	153.79	38.61	427.25	175.85

SUMS = summary
W = water
S = shoreline

Section J

Region 10. San Juan Islands-Northern Waters region, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Northern Waters Region, President Channel Subregion (1001)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	5.65		32.46	9.28
		PT=	20		100	30
		BOI=	0.36		2.09	0.57
	W	D=	0.14		0.27	2.56
		PT=	10		30	260
		BOI=	0.27		0.54	5.39
	Sums	PT=	30		130	290
		BOI=	0.63		2.63	5.97
Grebes	S	D=	3.19		3.77	22.90
		PT=	10		10	70
		BOI=	0.27		0.32	1.68
	W	D=	2.68		1.33	2.31
		PT=	270		130	230
		BOI=	7.93		4.05	6.45
	Sums	PT=	280		140	300
		BOI=	8.20		4.37	8.13
Cormorants	S	D=	2.46	9.57	10.20	6.67
		PT=	8	30	20	20
		BOI=	0.18	0.57	0.30	0.47
	W	D=			0.80	3.97
		PT=			80	400
		BOI=			1.84	8.97

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	Sums	PT=	8	30	100	420
		BOI=	0.18	0.57	2.13	9.44
Herons	S	D=	0.14		0.20	0.29
		PT=	<1		<1	<1
		BOI=	<0.01		<0.01	<0.01
	W	D=				0.02
		PT=				2
		BOI=				<0.01
	Sums	PT=	<1		<1	2
		BOI=	<0.01		<0.01	<0.01
Ducks and Geese	S	D=	10.43		4.31	88.41
		PT=	30		9	280
		BOI=	0.59		0.08	4.70
	W	D=	1.13	0.80	2.00	10.59[1]
		PT=	110	80	200	1,100
		BOI=	1.52	1.76	5.16	18.04
	Sums	PT=	140	80	210	1,400
		BOI=	2.11	1.76	5.24	22.74
Eagles and Hawks	S	D=	0.43		0.20	0.29
		PT=	1		<1	<1
		BOI=	<0.01		<0.01	<0.01

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Plovers	W	D=				0.20
		PT=				20
		BOI=				<0.01
Sandpipers and other shorebirds	S	D=				1.45
		PT=				5
		BOI=				0.05
Jaegers	S	D=			0.20	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	133.62	138.26	155.49	106.09
		PT=	430	440	310	340
		BOI=	8.09	8.38	3.24	5.59
	W	D=	4.23	8.40	12.27	40.13
		PT=	420	840	1,200	4,000
		BOI=	7.50	15.65	16.83	51.75
Sums		PT=	850	1,300	1,500	4,300
		BOI=	15.58	24.02	20.07	57.34
Alcids	S	D=	1.01	9.13	4.51	15.80
		PT=	3	30	10	50
		BOI=	0.11	1.12	0.49	2.49
	W	D=	0.42	6.02	5.33	13.59
		PT=	40	800	530	1,400
		BOI=	1.71	40.49	20.83	46.02

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	Sums	PT=	40	830	540	1,500
		BOI=	1.83	41.61	21.32	48.51
Summary	S	D=	157.25	157.39	143.75	257.54
		PT=	500	500	460	800
		BOI=	9.61	10.07	6.52	15.57
	W	D=	8.59	17.60	22.48	73.71
		PT=	860	1,800	2,200	7,400
		BOI=	18.95	57.89	49.24	136.62
	Sums	PT=	1,400	2,200	2,700	8,200
		BOI=	28.55	67.96	55.76	152.18

[1] Numbers adjusted to allow for small sample size.
SUMS = summary
W = water
S = shoreline

Table 2. *Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Northern Waters Region, Northern Areas Subregion (1002)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=			0.20	0.77
		PT=			<1	2
		BOI=			<0.01	0.03
	W	D=				6.47
		PT=				310
		BOI=				6.11
	Sums	PT=			<1	310
		BOI=			<0.01	6.14
Grebes	S	D=			0.98	5.77
		PT=			2	10
		BOI=			0.06	0.25
	W	D=			2.50	14.41[1]
		PT=			120	690
		BOI=			3.63	20.72
	Sums	PT=			10	700
		BOI=			0.42	20.97
Cormorants	S	D=	1.43	0.59	10.20	9.23
		PT=	3	1	20	20
		BOI=	0.07	0.03	0.30	0.41
	W	D=	0.83			6.47
		PT=	40			310
		BOI=	0.91			5.80

Table 2. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Sums		PT=	40	1	20	330
		BOI=	0.98	0.03	0.30	6.21
Herons	S	D=			0.20	0.58
		PT=			<1	1
		BOI=			<0.01	<0.01
Ducks and Geese	S	D=	2.86	2.35	4.31	21.15
		PT=	6	5	9	40
		BOI=	0.11	0.04	0.08	0.55
	W	D=	5.00			7.24[1]
		PT=	240			350
		BOI=	2.03			4.04
Sums		PT=	250	5	9	400
		BOI=	2.14	0.04	0.08	4.59
Eagles and Hawks	S	D=	1.43		0.20	0.38
		PT=	3		<1	<1
		BOI=	0.02		<0.01	<0.01
	W	D=	0.02[1]			
		PT=	1			
		BOI=	<0.01			
Sums		PT=	4		<1	<1
		BOI=	0.02		<0.01	<0.01

Table 2. (Continued)

Family	Area		Period Spring	Summer	Fall	Winter
Oystercatchers	W	D=				0.06[1]
		PT=				3
		BOI=				0.06
Sandpipers and other shorebirds	W	D=				0.58[1]
		PT=				30
		BOI=				0.14
Jaegers	S	D=			0.20	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	8.57	15.88	155.49	46.54
		PT=	2,030	310	90	
		BOI=	0.29	0.60	3.24	1.44
	W	D=	32.50	5.00	42.50	26.82[1]
		PT=	1,600	240	2,000	1,300
		BOI=	25.67	3.42	28.67	14.00
Sums		PT=	1,600	270	2,300	1,400
		BOI=	25.95	4.02	31.91	15.44
Alcids	S	D=	1.43	2.94	4.51	7.69
		PT=	3	6	9	20
		BOI=	0.16	0.32	0.49	0.69
	W	D=			8.33	78.12[1]
		PT=			400	3,700
		BOI=			12.90	121.40

Table 2. (Continued)

Family	Area		Spring	Summer	Fall	Winter
			Period			
Sums		PT=	3	6	410	3,700
		BOI=	0.16	0.32	13.39	122.09
Summary	S	D=	15.71	21.76	177.65	93.85
		PT=	30	40	360	190
		BOI=	0.64	0.99	4.18	3.39
	W	D=	39.17	5.00	56.67	
		PT=	1,900	240	2,700	6,700
		BOI=	28.89	3.42	45.20	172.29
Sums		PT=	1,900	280	3,100	6,900
		BOI=	29.53	4.41	49.39	175.68

[1] Numbers adjusted to allow for small sample size.

SUMS = summary
W = water
S = shoreline

Section K

Region 11. San Juan Islands-Interior Channels and Passages region, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Channels and Passages Region, Speiden Channel Subregion (1101)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	26.25		1.67	71.25
		PT=	30	*	2	80
		BOI=	0.58		0.04	1.58
	W	D=	0.05		0.41	15.40
		PT=	1		5	200
		BOI=	0.01		0.10	4.03
	Sums	PT=	30		7	100
		BOI=	0.59		0.14	5.61
Grebes	S	D=	16.25		116.67	7.50
		PT=	20	*	130	8
		BOI=	0.54		3.61	0.19
	W	D=	0.71		0.93	3.11
		PT=	9		10	40
		BOI=	0.22		0.33	1.16
	Sums	PT=	30		140	50
		BOI=	0.76		3.94	48.35
Cormorants	S	D=	10.00		138.33	30.00
		PT=	10	*	150	30
		BOI=	0.25		3.36	0.65
	W	D=	1.33	0.60	1.04	8.89
		PT=	20	8	10	110
		BOI=	0.35	0.15	0.27	2.51

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Sums		PT=	30	8	160	140
		BOI=	0.60	0.15	3.63	3.00
Herons	W	D=				0.03
		PT=				<1
		BOI=				<0.01
Ducks and Geese	S	D=				21.25
		PT=		*		20
		BOI=				0.45
	W	D=	0.28	0.52	0.55	1.75
		PT=	4	7	7	20
		BOI=	0.06	0.17	0.13	0.30
Sums		PT=	4	7	7	40
		BOI=	0.06	0.17	0.13	0.75
Eagles and Hawks	S	D=	1.25			
		PT=	1	*		
		BOI=	0.01			
	W	D=	0.05	0.09		0.20
		PT=	1	1		3
		BOI=	<0.01	0.01		0.02
Sums		PT=	2	1		3
		BOI=	0.01	0.01		0.02

Table 1. *(Continued)*

Family	Area		Period			
			Spring	Summer	Fall	Winter
Oystercatchers	S	D=				1.25
		PT=		*		1
		BOI=				0.03
Sandpipers and other shorebirds	S	D=				2.50
		PT=		*		3
		BOI=				0.03
Phalaropes	W	D=			0.47	
		PT=			6	
		BOI=			0.04	
Jaegers	W	D=			0.11	
		PT=			1	
		BOI=			<0.01	
Gulls and Terns	S	D=	12.50		318.33	111.25
		PT=	10	*	350	120
		BOI=	0.26		2.55	1.95
	W	D=	1.52	0.60	81.89	46.86
		PT=	20	8	1,000	590
		BOI=	0.33	0.14	9.41	5.62
Sums		PT=	30	8	1,400	710
		BOI=	0.59	0.14	11.96	7.58
Alcids	S	D=			8.33	10.00
		PT=		*	9	10
		BOI=			0.50	0.54

Table 1. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	W	D=	4.98	0.09	3.29	7.97
		PT=	60	1	41	100
		BOI=	2.42	0.04	1.83	4.27
	Sums	PT=	60	1	50	110
		BOI=	2.42	0.04	2.33	4.81
Summary	S	D=	66.25		585.00	255.00
		PT=	70	*	640	280
		BOI=	1.64		10.06	5.44
	W	D=	8.91	1.90	89.04	84.76
		PT=	110	20	1,100	1,100
		BOI=	3.40	0.51	12.11	17.90
	Sums	PT=	180	20	1,700	1,400
		BOI=	5.04	0.51	22.17	23.34

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Passages and Channels Region, Northern San Juan Channel Subregion (1102)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=				0.20
		PT=	*	*		1
		BOI=				0.01
	W	D=	0.02		1.54	1.42
		PT=	1		50	50
		BOI=	0.01		1.03	0.95
	Sums	PT=	1		50	50
		BOI=	0.01		1.03	0.96
Grebes	S	D=			0.13	0.41
		PT=	*	*	<1	1
		BOI=			0.01	0.02
	W	D=	0.07			0.41
		PT=	2			10
		BOI=	0.05			0.28
	Sums	PT=	2		<1	10
		BOI=	0.05		0.01	0.30
Cormorants	S	D=			0.13	1.07
		PT=	*	*	<1	3
		BOI=			0.01	0.07
	W	D=	0.21	0.04	0.30	1.08
		PT=	7	1	10	40
		BOI=	0.14	0.02	0.15	0.73

Table 2. (Continued)

Family	Area		Period Spring	 Summer	 Fall	 Winter
Sums		PT=	7	1	10	40
		BOI=	0.14	0.02	0.16	0.80
Herons	S	D=				0.05
		PT=	*	*		<1
		BOI=				<0.01
	W	D=	0.02			0.01
		PT=	1			<1
		BOI=	<0.01			<0.01
Sums		PT=	1			<1
		BOI=	<0.01			<0.01
Ducks and Geese	S	D=				4.69
		PT=	*	*		10
		BOI=				0.17
	W	D=	0.02		0.31	1.29
		PT=	1		10	40
		BOI=	0.01		0.27	0.60
Sums		PT=	1		10	50
		BOI=	0.01		0.27	0.77
Eagles and Hawks	S	D=				0.26
		PT=	*	*		1
		BOI=				0.01

Table 2. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
	W	D=	0.12	0.12	0.02	0.06
		PT=	4	4	1	2
		BOI=	0.03	0.03	<0.01	0.02
	Sums	PT=	4	4	1	3
		BOI=	0.03	0.03	<0.01	0.03
Phalaropes	S	D=			0.13	
		PT=	*	*	<1	
		BOI=			<0.01	
	W	D=			0.08	
		PT=			3	
		BOI=			0.02	
	Sums	PT=			3	
		BOI=			0.03	
Jaegers	W	D=			0.05	
		PT=			2	
		BOI=			<0.01	
Gulls and Terns	S	D=			11.56	11.28
		PT=	*	*	30	30
		BOI=			0.32	0.42
	W	D=	1.33	0.08	8.71	6.31
		PT=	40	3	290	210
		BOI=	0.78	0.05	2.91	2.95

Table 2. (Continued)

Family	Area		Spring	Summer	Fall	Winter
			Period			
	Sums	PT=	40	3	320	240
		BOI=	0.78	0.05	3.23	3.37
Alcids	S	D=	*	*	0.39	1.12
		PT=			1	3
		BOI=			0.05	0.16
	W	D=	0.84	0.04	0.40	10.18
		PT=	30	1	10	340
		BOI=	1.07	0.05	0.59	11.87
	Sums	PT=	30	1	10	340
		BOI=	1.07	0.05	0.64	12.03
Summary	S	D=	*	*	12.34	19.08
		PT=			40	60
		BOI=			0.38	0.85
	W	D=	2.68	0.28	11.40	20.77
		PT=	90	9	380	690
		BOI=	2.10	0.14	4.97	17.39
	Sums	PT=	90	9	420	750
		BOI=	2.10	0.14	5.35	18.24

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Channels and Passages Region, Southern San Juan Channel Subregion (1103)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	2.14			4.55
		PT=	10			20
		BOI=	0.22			0.38
	W	D=	0.08		0.91	5.54
		PT=	3		40	240
		BOI=	0.07		0.80	4.87
	Sums	PT=	10		40	260
		BOI=	0.29		0.80	5.25
Grebes	S	D=	29.29		3.33	10.45
		PT=	150		20	50
		BOI=	2.80		0.26	0.89
	W	D=	0.12		0.15	0.54
		PT=	5		7	23
		BOI=	0.16		0.20	0.60
	Sums	PT=	160		30	70
		BOI=	2.96		0.46	1.49
Shearwaters	W	D=			0.08	
		PT=			3	
		BOI=			0.02	
Storm-Petrels	S	D=			5.00	
		PT=			30	
		BOI=			0.21	

Table 3. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Cormorants	S	D=	78.57	200.00	341.67	33.64
		PT=	400	1,000	1,700	170
		BOI=	8.21	22.85	36.07	3.66
	W	D=		0.05	16.56[1]	66.25
		PT=		2	700	2,900
		BOI=		0.03	16.40	65.76
	Sums	PT=	400	1,000	2,400	3,100
		BOI=	8.21	22.88	52.47	69.42
Herons	S	D=	0.71		1.67	2.73
		PT=	4		8	10
		BOI=	0.02		0.04	0.07
Ducks and Geese	S	D=	45.00		0.30	100.45
		PT=	230		10	500
		BOI=	4.93		0.28	7.34
	W	D=				3.21
		PT=				140
		BOI=				2.01
	Sums	PT=	230		10	600
		BOI=	4.93		0.28	9.35
Eagles and Hawks	S	D=				0.45
		PT=				2
		BOI=				0.02

Table 3. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
Oystercatchers	S	D=	2.86			5.91
		PT=	10			30
		BOI=	0.32			0.65
Sandpipers and other shorebirds	S	D=	12.14			8.18
		PT=	60			40
		BOI=	0.71			0.22
Jaegers	W	D=			0.30	
		PT=			13	
		BOI=			0.02	
Gulls and Terns	S	D=	87.86	1350.00	678.33	143.18
		PT=	440	6,800	3,400	720
		BOI=	8.29	127.78	40.99	11.66
	W	D=	1.54	52.08[1]	36.59	10.00
		PT=	70	2,300	1,600	440
		BOI=	1.07	42.86	19.01	5.78
Sums		PT=	510	9,100	5,000	450
		BOI=	9.36	170.64	60.00	17.44
Alcids	S	D=	22.14	5.00	21.67	6.82
		PT=	110	30	110	30
		BOI=	3.58	1.26	3.49	1.30
	W	D=	0.55	24.57[1]	6.36	16.25
		PT=	20	1,100	280	710
		BOI=	0.98	53.70	10.91	25.44

Table 3. (Continued)

Family	Area			Spring	Summer	Fall	Winter
				Period			
	Sums		PT=	130	1,100	390	740
			BOI=	4.56	54.96	14.40	26.74
Summary		S	D=	280.71	1555.00	1055.00	316.36
			PT=	1,400	7,800	5,300	1,600
			BOI=	29.06	151.89	81.07	26.18
		W	D=	2.28	(15)[2]	(78)[2]	101.96
			PT=	100	3,400	2,600	4,400
			BOI=	2.27	96.59	47.36	104.46
	Sums		PT=	1,500	11,000	7,900	5,600
			BOI=	31.37	248.48	128.43	130.64

[1] Number adjusted for small sample size and occurrence of large numbers in dense flocks (i.e., Western Grebe, Arctic Loon, and Bonaparte's Gull feeding in tide-rips).

[2] Approximate.

SUMS = summary
W = water
S = shoreline

Table 4. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Channels and Passages Region, Wasp Pass Subregion (1104)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.99		0.57	2.15
		PT=	2		1	5
		BOI=	0.04		0.03	0.10
Grebes	S	D=	6.09		1.15	14.26
		PT=	20		3	40
		BOI=	0.29		0.07	0.80
Cormorants	S	D=	3.60	12.86	27.49	7.03
		PT=	9	30	70	20
		BOI=	0.20	0.73	1.54	0.37
Herons	S	D=			0.14	0.36
		PT=			<1	1
		BOI=			<0.01	<0.01
Ducks and Geese	S	D=	3.36		2.46	15.00
		PT=	8		6	40
		BOI=	0.15		0.12	0.51
Eagles and Hawks	S	D=			0.05	0.17
		PT=			<1	<1
		BOI=			<0.01	<0.01
Oystercatchers	S	D=	0.04		0.05	
		PT=	<1		<1	
		BOI=	<0.01		<0.01	

Table 4. (Continued)

Family	Area		Spring	Summer	Fall	Winter
				Period		
Phalaropes	S	D=			0.77	
		PT=			2	
		BOI=			0.01	
Jaegers	S	D=			0.02	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	8.97	115.00	30.33	20.84
		PT=	20	290	80	50
		BOI=	0.40	4.88	0.94	0.70
Alcids	S	D=	9.84	9.64	2.78	12.80
		PT=	20	24	7	30
		BOI=	1.00	1.22	0.26	1.23
Summary	S	D=	37.27	135.50	65.81	72.85
		PT=	100	340	160	180
		BOI=	2.09	6.83	3.00	3.72

SUMS = summary
W = water
S = shoreline

Table 5. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Channels and Passages Region, Upright Channel Subregion (1105)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=			0.89	1.97
		PT=			8	20
		BOI=			0.16	0.37
Grebes	W	D=	0.74		2.59	2.27
		PT=	7		20	20
		BOI=	0.14		0.64	0.40
Cormorants	W	D=	3.43	0.05	2.22	4.09
		PT=	30	<1	20	40
		BOI=	1.01	0.01	0.43	0.81
Ducks and Geese	W	D=			2.41	2.58
		PT=			20	20
		BOI=			0.33	0.29
Eagles and Hawks	W	D=	0.11			
		PT=	1			
		BOI=	0.01			
Jaegers	W	D=			0.19	
		PT=			2	
		BOI=			<0.01	
Gulls and Terns	W	D=	2.11	30.41	35.82	17.73
		PT=	20	270	320	160
		BOI=	0.30	5.05	3.80	2.37

Table 5. *(Continued)*

			Period		
Family	Area	Spring	Summer	Fall	Winter
Alcids	W D=	0.97	8.18	3.92	7.42
	PT=	9	70	30	70
	BOI=	0.40	3.61	1.27	2.26
Summary	W D=	7.49	38.64	48.04	36.06
	PT=	70	340	420	320
	BOI=	1.88	8.67	6.63	6.49

SUMS = summary
W = water
S = shoreline

Table 6. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Channels and Passages Region, Harney Channel Subregion (1106)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=				0.57
		PT=		*		1
		BOI=				0.02
	W	D=	1.34		1.15	3.86
		PT=	40		40	120
		BOI=	0.81		0.69	2.38
	Sums	PT=	40		40	120
		BOI=	0.81		0.69	2.40
Grebes	S	D=	1.25			4.38
		PT=	3	*		10
		BOI=	0.05			0.16
	W	D=	2.27		1.11	23.58
		PT=	70		30	720
		BOI=	1.72		0.98	20.52
	Sums	PT=	70		30	730
		BOI=	1.77		0.98	20.68
Cormorants	S	D=	0.56		0.25	1.81
		PT=	1	*	1	4
		BOI=	0.03		<0.01	0.09
	W	D=	1.07	2.09	2.88	5.18
		PT=	30	60	90	160
		BOI=	0.71	1.44	1.82	3.50

Table 6. (Continued)

Family	Area		Spring	Summer	Fall	Winter
			Period			
	Sums	PT=	30	60	90	160
		BOI=	0.74	1.44	1.82	3.59
Herons	S	D=				0.57
		PT=				1
		BOI=				0.01
	W	D=				0.29
		PT=				9
		BOI=				0.04
	Sums	PT=				10
		BOI=				0.05
Ducks and Geese	S	D=	0.42		0.50	9.52
		PT=	1	*	1	20
		BOI=	0.01		0.02	0.27
	W	D=	1.59	0.12	1.41	36.19
		PT=	50	4	40	1,100
		BOI=	1.14	0.09	0.76	22.93
	Sums	PT=	50	4	40	1,100
		BOI=	1.15	0.09	0.78	23.20
Eagles and Hawks	S	D=			0.25	0.29
		PT=		*	1	1
		BOI=			<0.01	<0.01

Table 6. (Continued)

Family	Area		Period			
			Spring	Summer	Fall	Winter
	W	D=	0.03	0.06	0.01	0.18
		PT=	1	2	<1	6
		BOI=	0.01	0.01	<0.01	0.04
	Sums	PT=	1	2	1	7
		BOI=	0.01	0.01	<0.01	0.05
Sandpipers and other shorebirds	W	D=	0.18			
		PT=	5			
		BOI=	0.02			
Phalaropes	W	D=			0.10	
		PT=			3	
		BOI=			0.02	
Gulls and Terns	S	D=	2.92		21.00	5.62
		PT=	6	*	50	10
		BOI=	0.12		0.56	0.15
	W	D=	3.71	3.53	7.20	10.09
		PT=	110	110	220	310
		BOI=	2.14	2.03	2.70	4.05
	Sums	PT=	120	110	270	320
		BOI=	2.26	2.03	3.26	4.20
Alcids	S	D=	3.06		0.25	1.81
		PT=	7	*	1	4
		BOI=	0.25		0.02	0.13

Table 6. *(Continued)*

				Period		
Family	Area		Spring	Summer	Fall	Winter
	W	D=	1.76	0.32	5.53	10.69
		PT=	50	10	170	330
		BOI=	2.13	0.40	5.77	11.77
	Sums	PT=	60	10	170	330
		BOI=	2.38	0.40	5.79	11.90
Summary	S	D=	8.19		22.25	24.57
		PT=	20	*	50	50
		BOI=	0.46		0.62	0.85
	W	D=	11.96	6.12	19.42	90.08
		PT=	370	190	600	2,800
		BOI=	8.67	3.98	12.74	65.22
	Sums	PT=	390	190	650	2,900
		BOI=	9.13	3.98	13.36	66.07

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 7. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Channels and Passages Region, Obstruction Pass Subregion (1107)

			Period			
Family	Area		Spring*	Summer*	Fall*	Winter*
Loons	S	D=				2.50
		PT=				6
		BOI=				0.14
Grebes	S	D=				35.00
		PT=				90
		BOI=				2.38
Cormorants	S	D=				10.83
		PT=				30
		BOI=				0.60
Ducks and Geese	S	D=				26.67
		PT=				70
		BOI=				0.78
Gulls and Terns	S	D=				181.67
		PT=				450
		BOI=				5.63
Alcids	S	D=				7.50
		PT=				20
		BOI=				0.73
Summary	S	D=				264.17
		PT=				660
		BOI=				10.25

*No data are available. SUMS = summary, W = water, S = shoreline

Table 8. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Islands and Channels Region, Thatcher Pass Subregion (1108)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	0.04			0.47
		PT=	<1			<1
		BOI=	<0.01			0.01
Grebes	S	D=	0.13		1.07	2.27
		PT=	<1		1	2
		BOI=	<0.01		0.03	0.05
Cormorants	S	D=	1.59	0.07	0.59	2.08
		PT=	1	<1	1	2
		BOI=	0.03	<0.01	0.01	0.04
Herons	S	D=		0.07	0.15	0.06
		PT=		<1	<1	<1
		BOI=		<0.01	<0.01	<0.01
Ducks and Geese	S	D=	0.35		0.26	2.86
		PT=	<1		<1	3
		BOI=	<0.01		<0.01	0.05
Eagles and Hawks	S	D=	0.04	0.07		0.25
		PT=	<1	<1		<1
		BOI=	<0.01	<0.01		<0.01
Phalaropes	S	D=			0.81	
		PT=			1	
		BOI=			<0.01	

Table 8. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Jaegers	S	D=			0.04	
		PT=			<1	
		BOI=			<0.01	
Gulls and Terns	S	D=	3.19	23.24	42.57	9.91
		PT=	3	20	40	9
		BOI=	0.05	0.25	0.37	0.11
Alcids	S	D=	2.26	1.22	3.97	4.22
		PT=	2	1	4	4
		BOI=	0.08	0.05	0.14	0.15
Summary	S	D=	7.61	24.66	49.67	22.14
		PT=	7	20	50	20
		BOI=	0.16	0.30	0.56	0.41

SUMS = summary
W = water
S = shoreline

Section L

Region 12. San Juan Islands-Interior Bays region, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. *Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, Mosquito/Roche Complex Subregion (1201)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	2.23		14.12	35.71
		PT=	20		140	360
		BOI=	0.41		2.85	7.34
Grebes	S	D=	16.70		65.10	47.43
		PT=	170		660	480
		BOI=	3.45		16.58	7.45
Cormorants	S	D=	7.48	6.00	65.69	13.29
		PT=	80	60	670	140
		BOI=	1.48	1.21	13.70	2.90
Herons	S	D=	0.39	5.00	2.75	2.14
		PT=	4	50	30	20
		BOI=	0.02	0.26	0.14	0.11
Ducks and Geese	S	D=	158.45		370.00	499.71
		PT=	1,600		3,800	5,100
		BOI=	24.90		77.41	69.26
Eagles and Hawks	S	D=				0.57
		PT=				6
		BOI=				0.04
Sandpipers and other shorebirds	S	D=			1.96	
		PT=			20	
		BOI=			0.05	

Table 1. *(Continued)*

Family	Area		Period Spring	Summer	Fall	Winter
Gulls and Terns	S	D=	22.33	19.00	190.39	32.43
		PT=	230	190	1,900	330
		BOI=	3.77	3.03	24.88	4.77
Alcids	S	D=	3.79	3.00	4.51	1.86
		PT=	40	30	50	20
		BOI=	1.35	1.06	1.87	0.65
Summary	S	D=	211.36	33.00	714.51	633.14
		PT=	2,200	340	7,300	6,500
		BOI=	35.38	5.55	137.49	92.54

SUMS = summary
W = water
S = shoreline

Table 2. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, Friday Harbor Subregion (1202)

			Period			
Family	Area		Spring	Summer	Fall*	Winter
Loons	S	D=	0.31			0.66
		PT=	<1			1
		BOI=	0.01			0.02
Grebes	S	D=	1.87			15.81
		PT=	3			20
		BOI=	0.05			0.47
Cormorants	S	D=	1.41			2.50
		PT=	2			4
		BOI=	0.04			0.08
Herons	S	D=				1.03
		PT=				2
		BOI=				0.01
Ducks and Geese	S	D=	0.47			40.15
		PT=	1			60
		BOI=	0.01			0.78
Eagles and Hawks	S	D=				0.07
		PT=				<1
		BOI=				<0.01
Gulls and Terns	S	D=	7.66	11.67		90.88
		PT=	10	20		140
		BOI=	0.21	0.33		1.63

Table 2. (Continued)

			Period			
Family	Area		Spring	Summer	Fall*	Winter
Alcids	S	D=	0.47	5.00		8.90
		PT=	1	8		10
		BOI=	0.02	0.38		0.64
Summary	S	D=	12.19	16.67		160.00
		PT=	20	30		240
		BOI=	0.35	0.71		3.63

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 3. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, Griffin Bay Subregion (1203)

			Period			
Family	Area		Spring	Summer*	Fall*	Winter
Loons	S	D=	1.43			5.00
		PT=	20			60
		BOI=	0.26			0.96
	W	D=				0.59
		PT=				4
		BOI=				0.09
	Sums	PT=	20			60
		BOI=	0.26			1.05
Grebes	S	D=	0.71			171.00
		PT=	9			2,100
		BOI=	0.26			40.66
	W	D=				7.65
		PT=				60
		BOI=				1.60
	Sums	PT=	9			2,200
		BOI=	0.26			42.26
Cormorants	S	D=	16.43			57.00
		PT=	200			680
		BOI=	4.22			14.83
	W	D=	2.73			6.47
		PT=	20			50
		BOI=	0.47			1.03

Table 3. (Continued)

			Period			
Family	Area		Spring	Summer*	Fall*	Winter
Sums		PT=	220			730
		BOI=	4.69			15.83
Herons	S	D=	0.71			
		PT=	9			
		BOI=	0.04			
Ducks and Geese	S	D=	32.14			828.00
		PT=	390			9,900
		BOI=	6.87			137.93
	W	D=	0.45			20.00
		PT=	3			150
		BOI=	0.09			2.61
Sums		PT=	390			10,000
		BOI=	6.96			140.54
Eagles and Hawks	S	D=	0.71			0.50
		PT=	9			6
		BOI=	0.06			0.04
Oystercatchers	S	D=				7.00
		PT=				80
		BOI=				1.85
Gulls and Terns	S	D=	12.14			81.00
		PT=	150			970
		BOI=	2.72			14.35

Table 3. (Continued)

				Period			
Family		Area		Spring	Summer*	Fall*	Winter
		W	D=	7.27			32.35
			PT=	50			240
			BOI=	1.00			2.78
	Sums		PT=	200			1,210
			BOI=	3.72			17.13
Alcids		S	D=	5.71			4.50
			PT=	70			50
			BOI=	3.29			2.00
		W	D=	0.45			14.12
			PT=	3			110
			BOI=	0.11			3.61
	Sums		PT=	70			160
			BOI=	3.40			5.61
Summary		S	D=	70.00			1154.00
			PT=	840			14,000
			BOI=	17.73			212.62
		W	D=	10.91			81.18
			PT=	80			610
			BOI=	1.66			11.72
	Sums		PT	920			15,000
			BOI=	19.39			224.34

*No data are available. SUMS = summary, W = water, S = shoreline

Table 4. *Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, Fisherman Bay Subregion (1205)*

			Period			
Family	Area		Spring*	Summer*	Fall*	Winter
Loons	S	D=				5.33
		PT=				10
		BOI=				0.16
Grebes	S	D=				69.78
		PT=				130
		BOI=				2.79
Cormorants	S	D=				2.44
		PT=				5
		BOI=				0.09
Herons	S	D=				3.33
		PT=				6
		BOI=				0.03
Ducks and Geese	S	D=				546.44
		PT=				1,000
		BOI=				15.52
Eagles and Hawks	S	D=				1.33
		PT=				3
		BOI=				0.02
Gulls and Terns	S	D=				64.44
		PT=				120
		BOI=				1.82

Table 4. (Continued)

				Period	
Family	Area	Spring*	Summer*	Fall*	Winter
Summary	S D= PT= BOI=				693.11 1,300 20.44

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 5. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, Swift's/Shoal Bays Subregion (1206)

		Period			
Family	Area	Spring*	Summer*	Fall*	Winter
Loons	S D=				0.67
	PT=				3
	BOI=				0.06
Grebes	S D=				11.60
	PT=				50
	BOI=				1.38
Cormorants	S D=				1.33
	PT=				6
	BOI=				0.14
Herons	S D=				0.40
	PT=				2
	BOI=				0.01
Ducks and Geese	S D=				93.47
	PT=				430
	BOI=				8.91
Eagles and Hawks	S D=				0.67
	PT=				3
	BOI=				0.02
Plovers	S D=				0.27
	PT=				1
	BOI=				<0.01

Table 5. (Continued)

Family	Area		Period			
			Spring*	Summer*	Fall*	Winter
Sandpipers and other shorebirds	S	D=				3.73
		PT=				20
		BOI=				0.15
Gulls and Terns	S	D=				28.93
		PT=				130
		BOI=				2.21
Alcids	S	D=				0.67
		PT=				3
		BOI=				0.11
Summary	S	D=				141.73
		PT=				650
		BOI=				12.99

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 6. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, Deer Harbor Subregion (1207)

			Period			
Family	Area		Spring*	Summer*	Fall*	Winter
Loons	S	D=				4.19
		PT=				8
		BOI=				0.17
Grebes	S	D=				13.87
		PT=				30
		BOI=				0.75
Cormorants	S	D=				0.32
		PT=				1
		BOI=				0.01
Ducks and Geese	S	D=				94.52
		PT=				190
		BOI=				3.05
Gulls and Terns	S	D=				5.16
		PT=				10
		BOI=				0.17
Alcids	S	D=				1.61
		PT=				3
		BOI=				0.11
Summary	S	D=				119.68
		PT=				240
		BOI=				4.27

*No data are available. SUMS = summary, W = water, S = shoreline

Table 7. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, West Sound Subregion (1208)

			Period			
Family	Area		Spring*	Summer*	Fall*	Winter
Loons	S	D=				2.79
		PT=				30
		BOI=				0.43
Grebes	S	D=				29.30
		PT=				270
		BOI=				6.24
Cormorants	S	D=				1.86
		PT=				20
		BOI=				0.37
Ducks and Geese	S	D=				112.56
		PT=				1,000
		BOI=				11.79
Gulls and Terns	S	D=				9.53
		PT=				90
		BOI=				1.33
Summary	S	D=				156.05
		PT=				1,400
		BOI=				20.17

*No data are available.
SUMS = summary
W = water
S = shoreline

Table 8. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, East Sound Subregion (1209)

			Period			
Family	Area		Spring*	Summer*	Fall*	Winter
Loons	S	D=				31.50
		PT=				20
		BOI=				0.31
Grebes	S	D=				39.50
		PT=				20
		BOI=				0.35
Cormorants	S	D=				3.00
		PT=				2
		BOI=				0.03
Ducks and Geese	S	D=				16.50
		PT=				8
		BOI=				0.10
Gulls and Terns	S	D=				27.50
		PT=				10
		BOI=				0.22
Alcids	S	D=				7.50
		PT=				4
		BOI=				0.13
Summary	S	D=				125.50
		PT=				60
		BOI=				1.15

*No data are available. SUMS = summary, W = water, S = shoreline

Table 9. Seasonal Projections of Density, Numbers, and Importance by Family for the San Juan Islands-Interior Bays Region, Lopez Sound Subregion (1210)

Family	Area		Period Spring*	Summer*	Fall	Winter*
Loons	S	D=			1.85	
		PT=			40	
		BOI=			0.72	
Grebes	S	D=			82.15	
		PT=			2,000	
		BOI=			48.93	
Cormorants	S	D=			25.08	
		PT=			600	
		BOI=			13.15	
Herons	S	D=			0.92	
		PT=			20	
		BOI=			0.11	
Ducks and Geese	S	D=			180.92	
		PT=			4,300	
		BOI=			100.59	
Gulls and Terns	S	D=			26.31	
		PT=			630	
		BOI=			7.89	
Alcids	S	D=			5.54	
		PT=			130	
		BOI=			4.57	

Table 9. *(Continued)*

Family	Area	Spring*	Summer*	Fall	Winter*
			Period		
Summary	S D=			322.77	
	PT=			7,700	
	BOI=			175.97	

*No data are available.
SUMS = summary
W = water
S = shoreline

Section M

Region 13. Canadian Waters region, subregion seasonal family densities, projected totals, and bird oil indices for SHORELINE, open WATER, and their SUMS where both occur for a family in a subregion. Unless otherwise noted, empty cells or cells not present indicate a lack of observations of appropriate species.

Table 1. Seasonal Projections of Density, Numbers, and Importance by Family for the Canadian Waters Region, Active Pass Subregion (1301)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	S	D=	232.66		3.97	57.00
		PT=	2,400		40	600
		BOI=	49.25		0.84	12.06
Grebes	S	D=	1.47		3.56	0.29
		PT=	20		40	3
		BOI=	0.45		0.78	0.07
Cormorants	S	D=	342.60		24.45	193.61
		PT=	3,600		260	2,000
		BOI=	73.79		5.20	42.65
Herons	S	D=		0.43	0.15	0.07
		PT=		5	2	1
		BOI=		0.02	0.01	<0.01
Ducks and Geese	S	D=	1.35	0.29	6.03	14.23
		PT=	10	3	60	150
		BOI=	0.30	0.07	1.56	2.16
Eagles and Hawks	S	D=	0.24	0.43	0.03	0.18
		PT=	3	5	<1	2
		BOI=	0.02	0.03	<0.01	0.01
Gulls and Terns	S	D=	92.54	10.29	67.66	105.29
		PT=	970	100	710	1,100
		BOI=	10.18	2.04	7.93	14.64

Table 1. *(Continued)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Alcids	S	D=	3.91	1.00	0.97	12.89
		PT=	40	10	10	140
		BOI=	1.36	0.33	0.38	4.44
Summary	S	D=	674.80	12.43	106.87	383.75
		PT=	7,100	130	1,100	4,000
		BOI=	135.35	2.49	16.71	76.04

SUMS = summary
W = water
S = shoreline

Table 2. *Seasonal Projections of Density, Numbers, and Importance by Family for the Canadian Waters Region, Canadian Gulf Islands Subregion (1302)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=	0.51		0.42	1.59
		PT=	70		60	230
		BOI=	1.48		1.19	4.60
Grebes	W	D=	0.71		0.17	2.77
		PT=	100		20	400
		BOI=	2.71		0.65	11.23
Cormorants	W	D=	1.43	0.47		9.65
		PT=	200	67		1,400
		BOI=	4.33	1.40		28.77
Herons	W	D=				0.01
		PT=				2
		BOI=				0.01
Ducks and Geese	W	D=	0.28	0.10	0.08	1.32
		PT=	40	10	10	190
		BOI=	0.86	0.28	0.21	4.36
Eagles and Hawks	W	D=	0.05	0.05	0.01	0.22
		PT=	7	7	1	30
		BOI=	0.05	0.05	0.01	0.23
Oystercatchers	W	D=				0.09
		PT=				10
		BOI=				0.29

Table 2. *(Continued)*

					Period	
Family	Area		Spring	Summer	Fall	Winter
Phalaropes	W	D=			0.01	
		PT=			1	
		BOI=			0.01	
Jaegers	W	D=			0.01	
		PT=			1	
		BOI=			<0.01	
Gulls and Terns	W	D=	14.39	1.77	6.97	16.73
		PT=	2,100	250	1,000	2,400
		BOI=	22.62	4.80	13.67	34.97
Alcids	W	D=	0.73	0.16	1.49	17.08
		PT=	100	20	210	2,400
		BOI=	3.68	0.92	7.05	79.21
Summary	W	D=	18.13	2.55	12.12	49.47
		PT=	2,600	360	1,700	7,100
		BOI=	35.74	7.44	31.74	163.66

SUMS = summary
W = water
S shoreline

Table 3. *Seasonal Projections of Density, Numbers, and Importance by Family for the Canadian Waters Region, Sidney Approach Subregion (1303)*

			Period			
Family	Area		Spring	Summer	Fall	Winter
Loons	W	D=	0.32		0.38	3.48
		PT=	40		40	410
		BOI=	0.64		0.87	8.15
Grebes	W	D=	0.73		0.23	3.92
		PT=	90		30	460
		BOI=	1.37		0.52	7.39
Cormorants	W	D=	3.55	1.90	3.92	9.54
		PT=	420	220	460	1,100
		BOI=	7.61	4.24	9.76	25.22
Herons	W	D=			0.20	
		PT=			23	
		BOI=			0.12	
Ducks and Geese	W	D=	6.24	0.05	3.45	41.28
		PT=	730	6	410	4,900
		BOI=	20.66	0.16	7.03	79.48
Eagles and Hawks	W	D=				0.18
		PT=				20
		BOI=				0.15
Oystercatchers	W	D=		0.11	0.02	0.33
		PT=		10	2	40
		BOI=		0.28	0.05	0.85

Table 3. (Continued)

			Period			
Family	Area		Spring	Summer	Fall	Winter
Plovers	W	D=				0.10
		PT=				10
		BOI=				0.06
Sandpipers and other shorebirds	W	D=				3.69
		PT=				430
		BOI=				2.48
Gulls and Terns	W	D=	5.38	48.70	16.03	39.33
		PT=	630	5,700	1,900	4,600
		BOI=	10.27	108.31	26.87	77.45
Alcids	W	D=	3.49	4.18	2.75	10.97
		PT=	410	490	320	1,300
		BOI=	14.18	22.82	11.85	43.07
Summary	W	D=	19.70	55.00	26.98	112.82
		PT=	2,300	6,500	3,200	13,000
		BOI=	54.73	135.82	57.08	244.31

SUMS = summary
W = water
S = shoreline

APPENDIX V

Regional and Subregional Summaries.

Table 1. Swiftsure Bank Region (01), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0101	Swiftsure Bank (and Region Totals)	Water	Den.	*	92.17	41.63	*
			PT		77,000	35,000	
			BOI		987.47	789.24	
			BOI/km^2		1.17	0.94	

*No data are available.

Table 2. Strait of Juan de Fuca-Outer Region (02), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0201	Strait of Juan de Fuca-Outer	Water	Den.	16.62	4.31	89.22	28.91
			PT	31,000	8,000	170,000	54,000
			BOI	412.38	231.38	4803.87	1525.30
			BOI/km^2	0.22	0.12	2.55	0.81
0202	Vancouver Island	Shoreline	Den.	85.61		255.18	80.88
			PT	4,400		13,000	4,200
			BOI	90.00	*	234.96	82.61
			BOI/km^2	1.75		4.56	1.60
0203	Cape Flattery	Shoreline	Den.	737.14	3,200.71	1,058.92	532.44
			PT	4,000	17,000	5,700	2,900
			BOI	78.49	338.91	97.81	53.45
			BOI/km^2	14.54	62.76	18.11	9.90
0204	Neah Bay	Shoreline	Den.	120.52	163.78	269.70	136.89
			PT	540	740	1,200	620
			BOI	9.18	11.80	19.98	9.46
			BOI/km^2	2.04	2.62	4.44	2.10
0205	Neah Bay to Clallam Bay	Shoreline	Den.	86.10	355.81	376.71	261.36
			PT	1,100	4,600	4,900	3,400
			BOI	22.98	73.52	96.00	57.67
			BOI/km^2	1.78	5.70	7.44	4.47
0206	Clallam Bay	Shoreline	Den.	51.99	46.18	259.05	109.45
			PT	170	150	830	350
			BOI	3.24	2.12	10.11	6.65
			BOI/km^2	1.01	0.66	3.16	2.08

Table 2. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0207	Clallam Bay to Crescent Bay	Shoreline	Den.	158.74	119.00	219.61	262.52
			PT	3,300	2,500	4,600	5,500
			BOI	80.88	30.62	61.10	79.56
			BOI/km^2	3.89	1.47	2.94	3.83
0208	Crescent Bay	Shoreline	Den.	217.00	91.54	204.90	180.00
			PT	240	100	230	200
			BOI	5.23	1.70	2.87	3.65
			BOI/km^2	4.75	1.55	2.61	3.32
0209	Crescent Bay to Ediz Hook	Shoreline	Den.	538.57	113.18	497.53	693.30
			PT	4,800	1,000	4,500	6,200
			BOI	70.11	20.48	75.26	105.30
			BOI/km^2	6.31	2.28	8.36	1.17
	Region Total	Shoreline	Den.	--	--	--	--
			PT	19,000	26,000	35,000	23,000
			BOI	360.11	479.15	598.09	398.35
			BOI/km^2	3.32	8.42	5.52	3.67
		Water	Den.	--	--	--	--
			PT	31,000	8,000	170,000	54,000
			BOI	412.38	231.38	4,803.81	1,525.30
			BOI/km^2	0.22	0.12	2.55	0.81

Table 2. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Summary	Den.	--	--	--	--
			PT	50,000	34,000	210,000	77,000
			BOI	772.49	710.53	5401.90	1923.65
			BOI/km^2	0.39	0.36	2.71	0.97

*No data are available.

Table 3. Strait of Juan de Fuca-Inner Region (03), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0301	Strait of Juan de Fuca (Inner)	Water	Den.	8.44	4.77	41.36	40.72
			PT	14,000	7,800	67,000	66,000
			BOI	473.05	178.24	1570.45	1383.05
			BOI/km^2	0.29	0.11	0.96	0.85
0302	Ediz Hook	Shoreline	Den.	34.08	28.66	75.54	31.15
			PT	10	10	30	10
			BOI	0.32	0.22	0.66	0.23
			BOI/km^2	0.80	0.55	1.65	0.58
0303	Port Angeles	Shoreline	Den.	65.29	44.98	286.63	164.77
			PT	680	470	3,000	1,700
			BOI	14.35	8.95	42.56	29.75
			BOI/km^2	1.38	0.86	4.09	2.86
0304	Voice of America	Shoreline	Den.	128.17	165.99	191.77	160.00
			PT	3,100	4,000	4,600	3,800
			BOI	76.06	77.91	90.95	55.34
			BOI/km^2	7.31	7.49	8.75	5.32
0305	Dungeness Spit	Shoreline	Den.	161.04	490.87	1,199.90	897.37
			PT	640	2,000	4,800	3,600
			BOI	14.48	34.11	66.84	32.49
			BOI/km^2	1.39	3.28	6.43	3.17
0306	Dungeness Bay/Harbor	Shoreline	Den.	512.04	243.10	600.01	729.81
			PT	6,100	2,900	7,200	8,800
			BOI	119.86	44.71	89.66	96.50
			BOI/km^2	11.53	4.30	8.62	9.28

Table 3. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0307	Jamestown	Shoreline	Den.	789.36	1,023.00	1,956.73	2,159.17
			PT	17,000	22,000	42,000	46,000
			BOI	348.82	402.77	342.89	587.90
			BOI/km^2	16.30	18.82	16.02	27.47
0308	Sequim Bay	Shoreline	Den.	150.41	29.32	272.08	283.07
			PT	2,400	470	4,400	4,600
			BOI	39.59	8.96	69.19	60.55
			BOI/km^2	3.36	0.76	5.86	5.13
		Water	Den.	17.44	1.24	82.13	20.83
			PT	280	20	1,300	340
			BOI	6.35	0.37	35.72	6.15
			BOI/km^2	3.18	0.19	17.86	3.08
		Summary	Den.	--	--	--	--
			PT	2,700	490	5,700	4,900
			BOI	45.94	9.33	104.91	66.70
			BOI/km^2	3.33	0.68	7.60	4.83
0309	Miller Peninsula	Shoreline	Den.	116.77	197.00	134.00	836.25
			PT	560	950	640	4,000
			BOI	12.49	18.27	9.35	73.95
			BOI/km^2	2.60	3.81	1.95	15.41
0310	Protection Island	Shoreline	Den.	169.09	585.06	329.86	201.83
			PT	2,400	8,100	4,600	2,800
			BOI	54.32	172.23	78.47	41.46
			BOI/km^2	17.52	55.56	25.31	13.37

Table 3. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0311	Discovery Bay	Shoreline	Den.	201.18	24.43	190.83	391.12
			PT	1,900	230	1,800	3,800
			BOI	42.14	5.29	35.36	65.08
			BOI/km^2	3.24	0.41	2.72	5.01
		Water	Den.	61.46	5.51	52.30	119.61
			PT	2,700	240	2,300	5,200
			BOI	72.28	8.61	62.72	135.91
			BOI/km^2	3.00	0.36	2.60	5.64
		Summary	Den.	--	--	--	--
			PT	4,600	470	4,100	9,000
			BOI	114.42	13.90	98.08	200.99
			BOI/km^2	3.08	0.37	2.64	5.42
0312	Quimper Peninsula	Shoreline	Den.	170.25	43.85	1152.00	493.77
			PT	1,800	470	12,000	5,300
			BOI	33.90	8.25	173.52	76.03
			BOI/km^2	3.17	0.77	16.22	7.11
0313	Whidbey Island	Shoreline	Den.			115.43	111.17
			PT	*	*	2,400	2,300
			BOI			44.32	57.90
			BOI/km^2			2.11	2.76
0314	Smith Island	Shoreline	Den.	1436.67	1430.00		7878.18
			PT	430	430		2,400
			BOI	12.01	8.37		19.24
			BOI/km^2	40.33	27.90		64.13

Table 3. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0315	Deception Pass	Shoreline	Den.	51.06	64.21	175.16	96.92
			PT	290	360	980	540
			BOI	6.93	11.34	21.29	12.17
			BOI/km^2	1.24	2.03	3.80	2.17
0316	Lopez Island (south shore)	Shoreline	Den.	1047.83	338.46	1252.33	712.11
			PT	9,300	1,400	11,000	6,300
			BOI	183.74	29.56	217.59	123.61
			BOI/km^2	20.64	3.32	24.45	13.89
0317	San Juan Island (south shore)	Shoreline	Den.	258.52	*	812.16	498.62
			PT	910		2,800	1,700
			BOI	11.45		46.10	19.78
			BOI/km^2	3.27		13.17	5.65
0318	Victoria, Vancouver Island	Shoreline	Den.	*	*	*	1110.00
			PT				7,700
			BOI				140.49
			BOI/km^2				20.36
	Region Total	Shoreline	Den.	--	--		
			PT	48,000	44,000	100,000	110,000
			BOI	970.46	830.94	1328.75	1492.97
			BOI/km^2	7.25	6.37	8.59	9.23
		Water	Den.	--	--	--	--
			PT	17,000	8,100	71,000	72,000
			BOI	551.68	187.22	1668.89	1525.11
			BOI/km^2	0.33	0.11	1.01	0.92

Table 3. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Summary	Den.	--	--	--	--
			PT	65,000	52,000	170,000	180,000
			BOI	1522.14	1018.16	2997.04	3018.08
			BOI/km^2	0.84	0.56	1.65	1.66

*No data are available.

Table 4. Admiralty Inlet Region (04), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0401	Admirality Inlet (and Region Total)	Shoreline	Den.	67.19	38.75	76.48	77.37
			PT	1,000	600	1,200	1,200
			BOI	13.52	12.83	25.71	31.50
			BOI/km^2	0.87	0.83	1.66	2.03
		Water	Den.	47.30	62.62	14.05	41.67
			PT	1,200	1,600	360	1,100
			BOI	26.46	65.09	6.36	21.38
			BOI/km^2	1.04	2.56	0.25	0.84
		Summary	Den.	--	--	--	--
			PT	2,200	2,200	1,600	2,300
			BOI	39.98	77.92	32.07	52.88
			BOI/km^2	0.98	1.91	0.78	1.29

Table 5. Anacortes to Hale Passage Region (05), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0501	Bellingham Channel	Shoreline	Den.	224.65	510.00	451.50	518.80
			PT	1,100	2,400	2,100	2,400
			BOI	20.21	46.36	37.14	35.00
			BOI/km^2	4.30	9.86	7.90	7.45
		Water	Den.	56.62	14.45	118.50	114.1
			PT	3,900	1,000	8,200	7,900
			BOI	84.00	28.69	395.74	186.39
			BOI/km^2	1.21	0.41	5.72	2.69
		Summary	Den.	--	--	--	--
			PT	5,000	3,400	10,000	10,000
			BOI	104.21	75.05	432.88	221.39
			BOI/km^2	1.41	1.02	5.86	3.00
0502	Guemes Channel	Shoreline	Den.	101.43			154.29
			PT	1,000	*	*	1,600
			BOI	24.04			30.81
			BOI/km^2	2.36			3.02
0503	Fidalgo Bay	Shoreline	Den.	173.78	33.82	107.13	430.87
			PT	2,000	380	1,200	5,000
			BOI	49.47	6.77	18.97	68.85
			BOI/km^2	4.30	0.59	1.65	5.99
0504	Padilla Bay	Shoreline	Den.	290.91	38.18	169.09	381.82
			PT	16,000	2,100	9,300	21,000
			BOI	463.68	41.96	89.96	346.63
			BOI/km^2	8.43	0.76	1.64	6.30

Table 5. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Water	Den.	1240.00		1040.00	2760.00
			PT	31,000	*	26,000	69,000
			BOI	618.35		404.09	1332.20
			BOI/km^2	24.73		16.16	53.29
		Summary	Den.	--	--	--	--
			PT	47,000	2,100	35,000	90,000
			BOI	1082.03	41.96	494.05	1678.83
			BOI/km^2	13.53	0.05	6.18	20.99
0505	Samish Bay	Shoreline	Den.	379.31	134.48	379.31	48.28
			PT	11,000	3,900	11,000	14,000
			BOI	445.08	19.04	141.47	218.95
			BOI/km^2	15.35	0.66	4.88	7.55
		Water	Den.	677.42	21.94	319.35	1580.65
			PT	21,000	680	9,900	49,000
			BOI	481.99	59.20	278.14	652.44
			BOI/km^2	13.03	1.57	7.52	17.63
		Summary	Den.	--	--	--	--
			PT	33,000	4,600	21,000	63,000
			BOI	927.07	78.24	419.61	871.40
			BOI/km^2	14.05	1.19	6.36	13.20
0506	Bellingham Bay	Shoreline	Den.	97.22	33.33	111.11	222.22
			PT	3,500	1,200	4,000	8,000
			BOI	61.60	24.18	80.74	171.70
			BOI/km^2	1.71	0.67	2.24	4.77

Table 5. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Water	Den.	67.21	9.01	147.54	26.23
			PT	8,200	1,100	18,000	32,000
			BOI	204.15	26.94	508.71	866.98
			BOI/km^2	1.67	0.22	4.17	7.11
		Summary	Den.	--	--	--	--
			PT	12,000	2,300	22,000	40,000
			BOI	265.75	51.12	589.45	1038.68
			BOI/km^2	1.68	0.32	3.73	6.57
0507	Hale Passage	Shoreline	Den.	126.18	23.70	24.63	77.51
			PT	2,000	380	400	1,200
			BOI	30.08	8.17	7.38	23.50
			BOI/km^2	1.87	0.51	0.46	1.46
	Region Total	Shoreline	Den.	--	--	--	--
			PT	37,000	10,000	28,000	53,000
			BOI	1094.13	109.99	375.67	885.45
			BOI/km^2	6.73	0.68	2.31	5.45
		Water	Den.	--	--	--	--
			PT	64,000	2,800	62,000	160,000
			BOI	1388.49	114.83	1586.68	3038.05
			BOI/km^2	5.48	0.45	6.27	12.00

Table 5. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Summary	Den.	--	--	--	--
			PT	100,000	13,000	90,000	210,000
			BOI	2482.62	224.82	1962.35	3923.46
			BOI/km^2	5.97	0.54	4.72	9.44

*No data are available.

Table 6. Georgia Strait--Eastern Region (06), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0601	Lummi Bay	Shoreline	Den.	2346.37	184.36	296.09	893.85
			PT	42,000	3,300	5,300	16,000
			BOI	548.08	17.97	68.03	148.00
			BOI/km^2	30.62	1.00	3.80	8.27
		Water	Den.	1125.00	110.00	150.00	775.00
			PT	9,000	880	1,200	6,200
			BOI	170.51	19.58	23.43	180.11
			BOI/km^2	21.31	2.45	2.93	22.13
		Summary	Den.	1969.11	162.16	250.97	849.42
			PT	51,000	4,200	6,500	22,000
			BOI	718.58	37.55	91.46	328.11
			BOI/km^2	27.74	1.45	3.53	12.67
0602	Cherry Point	Shoreline	Den.	1695.67	28.96	33.12	124.02
			PT	24,000	410	500	1,800
			BOI	583.00	8.39	9.65	29.50
			BOI/km^2	41.35	0.60	0.68	2.09
0603	Birch Bay	Shoreline	Den.	755.56	100.00	633.33	491.97
			PT	6,800	900	5,700	4,400
			BOI	154.77	17.07	89.22	96.63
			BOI/km^2	17.20	1.90	9.91	10.74
		Water	Den.	270.00	27.00	120.00	780.00
			PT	2,700	270	1,200	7,800
			BOI	55.56	5.13	29.05	65.68
			BOI/km^2	5.56	0.51	2.90	6.57

Table 6. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Summary	Den.	500.00	63.16	363.16	631.58
			PT	9,500	1,200	6,900	12,000
			BOI	210.33	22.19	118.27	162.31
			BOI/km^2	11.07	1.17	6.22	8.54
0604	Semiahoo Spit	Shoreline	Den.	1147.40	161.00	1030.93	1263.58
			PT	11,000	1,500	9,800	12,000
			BOI	220.27	29.89	262.35	179.09
			BOI/km^2	23.19	3.15	27.62	18.85
0605	Drayton Harbor	Shoreline	Den.	355.41	198.91	575.70	811.06
			PT	4,500	2,500	7,400	10,000
			BOI	67.55	33.05	77.90	119.67
			BOI/km^2	5.28	2.58	6.09	9.35
0606	Boundary Bay	Water	Den.	120.70	41.58	156.32	1146.34
			PT	18,000	6,300	24,000	94,000
			BOI	348.52	126.84	585.17	2000.63
			BOI/km^2	4.25	1.55	7.14	24.40
0607	San Juan Islands--Northern Tier	Shoreline	Den.	151.73	67.56	501.48	289.62
			PT	760	340	2,500	1,400
			BOI	12.42	8.08	43.30	28.58
			BOI/km^2	2.48	1.60	8.66	5.72
		Water	Den.	116.67	6.00	34.44	352.00
			PT	3,400	180	1,000	10,000
			BOI	55.23	5.18	29.93	233.02
			BOI/km^2	1.88	0.18	1.02	7.93

Table 6. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Summary	Den.	122.09	15.12	98.84	319.77
			PT	4,200	520	3,400	11,000
			BOI	67.65	13.25	73.21	261.60
			BOI/km^2	1.97	0.39	2.13	7.60
0608	Georgia Strait	Water	Den.	45.09	9.37	58.97	72.84
			PT	13,000	2,700	17,000	21,000
			BOI	280.84	62.64	380.12	538.33
			BOI/km^2	0.97	0.22	1.32	1.87
	Region Total	Shoreline	Den.	1320.47	133.53	459.94	682.49
			PT	89,000	9,000	31,000	46,000
			BOI	1586.10	114.45	550.44	601.46
			BOI/km^2	23.53	1.70	8.17	8.92
		Water	Den.	126.89	23.94	105.34	359.11
			PT	53,000	10,000	44,000	150,000
			BOI	910.66	219.37	1047.69	3017.76
			BOI/km^2	2.18	0.53	2.51	7.22
		Summary	Den.	288.60	39.17	154.61	412.29
			PT	140,000	19,000	75,000	200,000
			BOI	2496.76	333.82	1598.13	3619.23
			BOI/km^2	5.15	0.69	3.29	7.46

Table 7. Georgia Strait--Western Region (07), Summaries of Subregion

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0701	Pt. Roberts	Shoreline	Den.	489.12	138.71	133.26	751.81
			PT	8,000	2,300	2,200	12,000
			BOI	178.81	45.00	36.25	228.67
			BOI/km^2	10.97	2.76	2.22	14.03
0702	Tsawwassen Bay	Shoreline	Den.	7176.84	233.08	1270.83	1480.53
			PT	44,000	1,400	7,800	9,000
			BOI	862.41	27.36	118.33	119.14
			BOI/km^2	141.38	4.48	19.40	19.53
0703	Georgia Strait	Water	Den.	8.03	1.63	2.89	5.97
			PT	2,900	600	1,100	2,100
			BOI	62.63	11.74	16.05	43.51
			BOI/km^2	0.17	0.03	0.04	0.12
	Region Total	Shoreline	Den.	2321.43	165.18	446.43	937.50
			PT	52,000	3,700	10,000	21,000
			BOI	1041.22	72.36	154.58	347.80
			BOI/km^2	46.48	3.23	6.90	15.53
		Water	Den.	2.03	1.63	2.89	5.97
			PT	2,900	600	1,100	2,100
			BOI	62.63	11.74	16.05	43.51
			BOI/km^2	0.17	0.03	0.04	0.12
		Summary	Den.	142.16	10.34	28.43	59.45
			PT	55,000	4,000	11,000	23,000
			BOI	1103.84	84.10	170.63	391.32
			BOI/km^2	2.85	0.22	0.44	1.01

Table 8. Haro Strait Region (08), Summaries of Subregion

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0801	Northern Haro Strait	Shoreline	Den.	179.67	249.69	450.79	320.86
			PT	1,700	2,400	4,300	3,100
			BOI	31.38	50.81	72.13	47.78
			BOI/km^2	3.27	5.29	7.51	4.98
		Water	Den.	3.33	6.84	10.33	24.29
			PT	1,100	2,300	3,400	8,000
			BOI	23.39	52.57	45.13	160.47
			BOI/km^2	0.07	0.02	0.14	0.49
		Summary	Den.	8.27	13.58	27.73	32.48
			PT	2,800	4,600	7,700	11,000
			BOI	54.77	103.38	117.26	208.25
			BOI/km^2	0.16	0.31	0.35	0.61
0802	Southern Haro Strait	Shoreline	Den.	50.73	39.35	346.16	126.24
			PT	250	200	1,700	630
			BOI	3.75	3.87	27.04	10.45
			BOI/km^2	0.75	0.77	5.41	2.09
		Water	Den.	4.83	1.60	4.38	12.75
			PT	1,100	350	1,000	2,800
			BOI	23.20	9.12	21.66	57.91
			BOI/km^2	0.11	0.04	0.10	0.26
		Summary	Den.	6.24	2.45	12.03	15.15
			PT	1,400	550	2,700	3,400
			BOI	26.96	13.00	57.80	68.35
			BOI/km^2	0.12	0.06	0.26	0.30

Table 8. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
	Region Total	Shoreline	Den.	136.99	178.08	410.96	253.42
			PT	2,000	2,600	6,000	3,700
			BOI	35.13	54.69	99.17	58.23
			BOI/km^2	2.41	3.75	6.79	3.99
		Water	Den.	4.01	4.92	8.02	20.05
			PT	2,200	2,700	4,400	11,000
			BOI	46.59	61.69	66.79	218.38
			BOI/km^2	0.09	0.11	0.12	0.40
		Summary	Den.	7.46	9.41	17.76	26.64
			PT	4,200	5,300	10,000	15,000
			BOI	81.73	116.38	165.97	276.61
			BOI/km^2	0.15	0.21	0.29	0.49

Table 9. Rosario Strait Region (09), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0901	Southern Rosario Strait	Shoreline	Den.	95.41	134.17	421.22	211.78
			PT	1,000	1,400	4,600	2,300
			BOI	20.85	30.77	101.87	56.51
			BOI/km^2	1.93	2.85	9.43	5.23
		Water	Den.	7.11	7.02	73.72	81.66
			PT	800	800	8,300	9,200
			BOI	17.43	14.32	182.57	235.72
			BOI/km^2	0.16	0.13	1.62	2.10
		Summary	Den.	14.61	17.86	105.52	97.40
			PT	1,800	2,200	13,000	12,000
			BOI	38.28	45.09	284.44	292.23
			BOI/km^2	0.31	0.37	2.31	2.37
0902	Central Rosario Strait	Shoreline	Den.	117.14	182.50	660.19	361.32
			PT	430	680	2,400	1,300
			BOI	7.68	12.53	38.43	18.38
			BOI/km^2	2.08	3.39	10.39	4.97
		Water	Den.	12.00	1.39	176.32	77.80
			PT	950	110	14,000	6,200
			BOI	23.84	2.15	386.59	133.38
			BOI/km^2	0.30	0.03	4.87	1.68
		Summary	Den.	16.85	9.39	192.54	104.69
			PT	1,400	780	16,000	8,700
			BOI	31.52	14.68	425.03	151.77
			BOI/km^2	0.38	0.18	5.11	1.83

Table 9. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
0903	Northern Rosario Strait	Shoreline	Den.	455.31	148.22	288.44	179.04
			PT	1,500	490	930	590
			BOI	25.74	9.68	13.53	11.22
			BOI/km^2	7.80	2.93	4.10	3.40
		Water	Den.	74.37	15.32	178.25	74.71
			PT	6,600	1,400	16,000	6,600
			BOI	128.05	28.93	413.74	164.62
			BOI/km^2	1.44	0.33	4.65	1.85
		Summary	Den.	87.85	20.61	184.38	78.09
			PT	8,100	1,900	17.000	7,200
			BOI	153.79	38.61	427.25	175.85
			BOI/km^2	1.67	0.42	4.63	1.91
	Region Total	Shoreline	Den.	162.92	146.07	443.82	235.96
			PT	2,900	2,600	7,900	4,200
			BOI	54.26	52.98	153.83	86.12
			BOI/km^2	3.05	2.98	8.64	4.84
		Water	Den.	29.93	8.19	138.94	7.84
			PT	8,400	2,300	39,000	22,000
			BOI	169.33	45.40	982.90	533.73
			BOI/km^2	0.60	0.16	3.50	1.90
		Summary	Den.	36.85	16.42	157.45	87.10
			PT	11,000	4,900	47,000	26,000
			BOI	223.59	98.38	1136.73	619.85
			BOI/km^2	0.75	0.33	3.81	2.08

Table 10. San Juan Islands--Northern Waters Region (10), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
1001	President Channel	Shoreline	Den.	157.25	157.39	143.75	257.54
			PT	500	500	460	800
			BOI	9.61	10.07	6.52	15.57
			BOI/km^2	3.00	3.15	2.04	4.87
		Water	Den.	8.59	17.60	22.48	73.71
			PT	860	1,800	2,200	7,400
			BOI	18.95	57.89	49.24	136.62
			BOI/km^2	0.19	0.58	0.49	1.36
		Summary	Den.	13.51	21.24	26.06	79.15
			PT	1,400	2,200	2,700	8,200
			BOI	28.55	67.96	55.76	152.18
			BOI/km^2	0.28	0.66	0.54	1.47
1002	Northern Areas	Shoreline	Den.	15.71	21.76	177.65	93.85
			PT	30	40	360	190
			BOI	0.64	0.99	4.18	3.39
			BOI/km^2	0.32	0.49	2.09	1.70
		Water	Den.	39.17	5.00	56.67	139.58
			PT	1,900	240	2,700	6,700
			BOI	28.89	3.42	45.20	172.29
			BOI/km^2	0.60	0.07	0.94	3.59
		Summary	Den.	39.00	5.60	62.00	154.00
			PT	1,900	280	3,100	7,700
			BOI	29.53	4.41	49.39	190.51
			BOI/km^2	0.59	0.09	0.99	3.81

Table 10. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
Region Total		Shoreline	Den.	101.92	103.85	153.85	192.31
			PT	530	540	800	1,000
			BOI	10.24	11.06	10.70	18.97
			BOI/km^2	1.97	2.22	2.06	3.65
		Water	Den.	18.87	13.48	33.02	94.34
			PT	2,800	2,000	4,900	14,000
			BOI	47.84	61.32	94.44	308.91
			BOI/km^2	0.32	0.41	0.64	2.08
		Summary	Den.	21.48	16.28	37.11	97.65
			PT	3,300	2,500	5,700	15,000
			BOI	58.08	72.37	105.15	327.87
			BOI/km^2	0.38	0.47	0.68	2.13

Table 11. *San Juan Islands--Interior Channels and Passages Region (1100), Summaries of Subregion*

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
1101	Speiden Channel	Shoreline	Den.	66.25		585.00	255.00
			PT	70	*	640	280
			BOI	1.64		10.06	5.44
			BOI/km^2	1.49		9.15	4.95
		Water	Den.	8.91	1.90	89.04	84.76
			PT	110	20	1,100	1,100
			BOI	3.40	0.51	12.11	17.90
			BOI/km^2	0.27	0.04	0.96	1.42
		Summary	Den.	--	--	--	--
			PT	180	20	1,700	1,400
			BOI	5.04	0.51	22.17	23.34
			BOI/km^2	0.37	0.04	1.62	1.70
1102	Northern San Juan Channel	Shoreline	Den.			12.34	19.08
			PT	*	*	0.40	0.60
			BOI			0.38	0.85
			BOI/km^2			0.13	0.29
		Water	Den.	2.68	0.28	11.40	20.77
			PT	90	9	380	690
			BOI	2.10	0.14	4.97	17.39
			BOI/km^2	0.06	<0.01	0.15	0.52
		Summary	Den.	--	--	--	--
			PT	90	9	420	750
			BOI	2.10	0.14	5.35	18.24
			BOI/km^2	0.06	<0.01	0.15	0.51

Table 11. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
1103	Southern San Juan Channel	Shoreline	Den.	280.71	1555.00	1055.00	316.36
			PT	1,400	7,800	5,300	1,600
			BOI	29.06	151.89	81.07	26.18
			BOI/km^2	5.81	30.38	16.21	5.24
		Water	Den.	2.28	(15)**	(78)**	101.96
			PT	100	3,400	2,600	4,400
			BOI	2.27	96.59	47.36	104.46
			BOI/km^2	0.05	2.22	1.09	2.40
		Summary	Den.	--	--	--	--
			PT	1,500	11,000	7,900	5,600
			BOI	31.37	248.48	128.43	130.64
			BOI/km^2	0.65	5.12	2.65	2.69
1104	Wasp Pass	Shoreline	Den.	37.27	135.50	65.81	72.85
			PT	100	340	160	180
			BOI	2.09	6.83	3.00	3.72
			BOI/km^2	0.84	2.73	1.20	1.49
1105	Upright Channel	Water	Den.	7.49	38.64	48.04	36.06
			PT	70	340	420	320
			BOI	1.88	8.67	6.63	6.49
			BOI/km^2	0.21	0.99	0.75	0.74
1106	Harney Channel	Shoreline	Den.	8.19		22.25	24.57
			PT	20	*	50	50
			BOI	0.46		0.62	0.85
			BOI/km^2	0.21		0.28	0.39

Table 11. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Water	Den.	11.96	6.12	19.42	90.08
			PT	370	190	600	2,800
			BOI	8.67	3.98	12.74	65.22
			BOI/km^2	0.28	0.13	0.41	2.12
		Summary	Den.	--	--	--	--
			PT	390	190	650	2,900
			BOI	9.13	3.98	13.36	66.07
			BOI/km^2	0.28	0.13	0.41	2.01
1107	Obstruction Pass	Shoreline	Den.				264.17
			PT	*	*	*	660
			BOI				10.25
			BOI/km^2				4.10
1108	Thatcher Pass	Shoreline	Den.	7.61	24.66	49.67	22.14
			PT	7	20	50	20
			BOI	0.16	0.30	0.56	0.41
			BOI/km^2	0.18	0.33	0.62	0.46
	Region Total	Shoreline	Den.	--	--	--	--
			PT	2,100	8,200	6,200	2,900
			BOI	33.41	159.02	95.69	47.70
			BOI/km^2	2.86	18.93	6.55	2.79
		Water	Den.	--	--	--	--
			PT	740	4,000	5,100	9,300
			BOI	18.32	109.89	83.81	211.46
			BOI/km^2	0.14	0.85	0.65	1.64

Table 11. *(Continued)*

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Summary	Den.	--	--	--	--
			PT	2,800	12,000	11,000	12,000
			BOI	51.73	268.91	179.50	259.16
			BOI/km^2	0.37	1.96	1.25	1.78

*No data are available.
**Adjusted.

Table 12. San Juan Islands--Interior Bays Region (12), Summaries of Subregions

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
1201	Mosquito/Roche Complex	Shoreline	Den.	211.36	33.00	714.51	633.14
			PT	2,200	340	7,300	6,500
			BOI	35.38	5.55	137.49	92.54
			BOI/km^2	3.47	0.54	13.48	9.07
1202	Friday Harbor	Shoreline	Den.	12.19	16.67		160.00
			PT	20	30	*	240
			BOI	0.35	0.71		3.63
			BOI/km^2	0.23	0.47		2.42
1203	Griffin Bay	Shoreline	Den.	70.00			1154.00
			PT	840	*	*	14,000
			BOI	17.73			212.62
			BOI/km^2	1.48			17.92
		Water	Den.	10.91			81.18
			PT	80	*	*	610
			BOI	1.66			11.72
			BOI/km^2	0.22			1.56
		Summary	Den.	--	--	--	--
			PT	920	*	*	15,000
			BOI	19.39			224.34
			BOI/km^2	0.99			11.50
1205	Fisherman Bay	Shoreline	Den.				693.11
			PT	*	*	*	1,300
			BOI				20.44
			BOI/km^2				10.76

Table 12. (Continued)

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
1206	Swift's/Shoal Bays	Shoreline	Den.	*	*	*	141.73
			PT				650
			BOI				12.99
			BOI/km^2				2.82
1207	Deer Harbor	Shoreline	Den.	*	*	*	119.68
			PT				240
			BOI				4.27
			BOI/km^2				2.14
1208	West Sound	Shoreline	Den.	*	*	*	156.05
			PT				1,400
			BOI				20.17
			BOI/km^2				2.22
1209	East Sound	Shoreline	Den.	*	*	*	125.50
			PT				60
			BOI				1.15
			BOI/km^2				2.30
1210	Lopez Sound	Shoreline	Den.	*	*	322.77	*
			PT			7,700	
			BOI			175.97	
			BOI/km^2			7.36	
	Region Total	Shoreline	Den.	--	--	--	--
			PT	3,100	370	15,000	24,000
			BOI	53.46	6.26	313.46	367.81
			BOI/km^2	1.71	0.54	9.19	8.80

Table 12. (Continued)

Subregion				Season			
Code	**Name**	**Area**		**Spring**	**Summer**	**Fall**	**Winter**
		Water	Den.				
			PT	80	*	*	610
			BOI	1.66			11.72
			BOI/km^2	0.22			1.56
		Summary	Den.	--	--	--	--
			PT	3,200	370	15,000	25,000
			BOI	55.12	6.26	313.46	379.53
			BOI/km^2	1.77	0.54	9.19	7.70

*No data are available.

*Table 13. Canadian Waters Region (13), Summaries of Subregions**

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
1301	Active Pass	Shoreline	Den.	666.67	12.38	104.76	383.75
			PT	7,000	130	1,100	4,000
			BOI	135.35	2.49	16.70	76.04
			BOI/km^2	12.89	0.24	1.59	7.24
1302	Canadian Gulf Islands	Water	Den.	18.19	2.52	11.90	49.47
			PT	2,600	360	1,700	7,100
			BOI	35.74	7.44	31.72	163.66
			BOI/km^2	0.25	0.05	0.22	1.15
1303	Sidney Approach	Water	Den.	19.57	54.47	27.23	112.82
			PT	2,300	6,400	3,200	13,000
			BOI	54.73	135.82	57.07	244.31
			BOI/km^2	0.47	1.16	0.49	2.08
	Region Total	Shoreline	Den.	--	--	--	--
			PT	7,000	130	1,100	4,000
			BOI	135.35	2.49	16.70	76.04
			BOI/km^2	12.89	0.24	1.59	7.24
		Water	Den.	--	--	--	--
			PT	4,900	6,800	4,900	20,000
			BOI	71.36	143.26	88.80	407.97
			BOI/km^2	0.27	0.55	0.34	1.57

Table 13. *(Continued)*

Subregion				Season			
Code	Name	Area		Spring	Summer	Fall	Winter
		Summary	Den.	--	--	--	--
			PT	12,000	8,100	6,000	24,000
			BOI	206.71	145.75	105.50	484.01
			BOI/km^2	0.76	0.54	0.39	1.79

*Not comparable with other regions for Projected Totals.

APPENDIX VI

Bird-Oil Indices and Bird-Oil Indices/km^2 ratings of subregions by season.

Table 1. Seasonal Bird-Oil Ratings for Each Subregion

Subregion		Season							
Code	Name	Spring		Summer		Fall		Winter	
		BOI	BOI/km^2	BOI	BOI/km^2	BOI	BOI/km^2	BOI	BOI/km^2
0101	Swiftsure Bank	--		17	5	15	4	--	
0201	Strait of Juan de Fuca (outer)	12	1	10	1	21	6	18	4
0202	Vancouver Island	5	5	--		10	6	5	5
0203	Cape Flattery	5	9	11	14	5	9	4	8
0204	Neah Bay	2	5	2	6	2	6	2	5
0205	Neah Bay to Clallam Bay	2	5	4	7	5	7	4	6
0206	Clallam Bay	2	6	2	5	2	9	2	7
0207	Clallam Bay to Cresecent Bay	5	6	3	5	4	6	5	6
0208	Crescent Bay	2	6	2	5	2	6	2	6
0209	Crescent Bay to Ediz Hook	4	7	2	5	4	8	6	5
0301	Strait of Juan de Fuca (inner)	12	2	9	1	18	4	18	4
0302	Ediz Hook	3	4	2	3	4	5	2	3
0303	Port Angeles	2	5	2	4	3	6	3	6
0304	Voice of America	5	7	5	7	5	8	4	7
0305	Dungeness Spit	2	5	3	6	4	7	3	6
0306	Dungeness Bay/Harbor	6	9	3	6	5	8	5	8
0307	Jamestown	11	9	12	9	11	9	13	10
0308	Sequim Bay	3	6	1	3	2	8	2	6
0309	Miller Peninsula	2	6	2	6	2	5	4	9
0310	Protection Island	4	9	8	13	5	10	3	9
0311	Discovery Bay	6	6	2	2	5	6	10	7
0312	Quimper Peninsula	3	6	2	4	8	9	5	7
0313	Whidbey Island	--		--		3	5	4	6
0314	Smith Island	2	12	2	10	--		2	14
0315	Deception Pass	2	5	2	5	2	6	2	5
0316	Lopez Island (south shore)	9	10	3	6	10	10	6	9

Table 1. *(Continued)*

Subregion		Season							
		Spring		Summer		Fall		Winter	
Code	Name	BOI	BOI/km^2	BOI	BOI/km^2	BOI	BOI/km^2	BOI	BOI/km^2
0317	San Juan Island (south shore)	2	6	--		3	9	2	7
0318	Victoria, Vancouver Island	--		--		--		7	10
0401	Admiralty Inlet	3	4	5	5	3	4	4	5
0501	Bellingham Channel	6	5	4	5	12	7	10	6
0502	Guemes Channel	2	5	--		--		3	6
0503	Fidalgo Bay	3	6	2	3	2	5	4	7
0504	Padilla Bay	18	9	3	1	12	7	18	10
0505	Samish Bay	17	9	5	5	12	7	16	9
0506	Bellingham Bay	10	5	4	2	13	6	18	7
0507	Hale Passage	3	5	2	3	2	2	2	5
0601	Lummi Bay	15	10	3	5	5	6	11	9
0602	Cherry Point	13	12	2	3	2	3	3	5
0603	Birch Bay	10	9	2	5	6	7	8	8
0604	Semiahmoo Spit	10	10	3	6	10	10	9	9
0605	Drayton Harbor	4	7	3	6	5	7	6	8
0606	Boundary Bay	11	6	7	5	13	7	19	10
0607	San Juan Islands--Northern Tier	4	5	2	2	4	5	10	8
0608	Georgia Strait--Eastern	10	4	4	1	11	5	13	5
0701	Pt. Roberts	9	9	3	6	3	5	10	9
0702	Tsawwassen Bay	16	18	3	6	6	9	6	9
0703	Georgia Strait--Western	4	1	2	1	2	1	3	1
0801	Northern Haro Strait	3	6	4	7	4	8	3	6
0802	Southern Haro Strait	3	1	2	1	4	2	4	2
0901	Southern Rosario Strait	3	2	3	2	10	5	10	5
0902	Central Rosario Strait	3	2	2	1	12	7	8	5

Table 1. (Continued)

Subregion		Season							
		Spring		Summer		Fall		Winter	
Code	Name	BOI	BOI/km^2	BOI	BOI/km^2	BOI	BOI/km^2	BOI	BOI/km^2
0903	Northern Rosario Strait	8	5	3	2	12	6	9	5
1001	President Channel	3	2	4	3	3	3	8	5
1002	Northern Areas	3	3	2	1	3	4	9	6
1101	Speiden Channel	2	2	1	1	2	5	2	5
1102	Northern San Juan Channel	2	1	1	1	2	1	2	3
1103	Southern San Juan Channel	3	3	10	7	7	6	7	6
1104	Wasp Pass	2	4	2	6	2	5	2	5
1105	Upright Channel	2	1	2	4	2	3	2	3
1106	Harney Channel	2	2	2	1	2	2	4	5
1107	Obstruction Pass	--		--		--		2	6
1108	Thatcher Pass	2	1	3	2	4	3	3	2
1201	Mosquito/Roche Complex	3	6	2	3	7	9	5	8
1202	Friday Harbor	1	1	1	2	--		2	5
1203	Griffin Bay	2	4	--		--		10	9
1205	Fisherman Bay	--		--		--		2	9
1206	Swifts/Shoal Bays	--		--		--		2	5
1207	Deer Harbor	--		--		--		2	5
1208	West Sound	--		--		--		2	5
1209	East Sound	--		--		--		2	5
1210	Lopez Sound	--		--		9	7	--	
1301	Active Pass	7	9	2	1	2	5	4	7
1302	Canadian Gulf Islands	3	1	2	1	3	1	8	5
1303	Sidney Approach	4	2	7	5	4	2	10	5

Table 2. BOI and BOI/km^2 Value Intervals and Rating Classifications

BOI	Rating	BOI/km^2	Rating
0 - 1	1	0 - 0.25	1
>1 - 25	2	0.26 - 0.50	2
26 - 50	3	0.51 - 0.75	3
51 - 75	4	0.76 - 1.00	4
76 - 100	5	1.01 - 2.50	5
101 - 125	6	2.51 - 5.00	6
121 - 150	7	5.01 - 7.50	7
151 - 175	8	7.51 - 10.00	8
171 - 200	9	10.01 - 20	9
201 - 300	10	20.01 - 30	10
301 - 400	11	30.01 - 40	11
401 - 500	12	40.01 - 50	12
501 - 600	13	50.01 - 60	13
601 - 700	14	60.01 - 70	14
701 - 800	15	70.01 - 80	15
801 - 900	16	80.01 - 90	16
901 - 1,000	17	90.01 - 100	17
1,001 - 2,000	18	>100	18
2,001 - 3,000	19		
3,001 - 4,000	20		
4,001 - 5,000	21		
>5,000	22		

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